GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

Power

June
1954·50¢

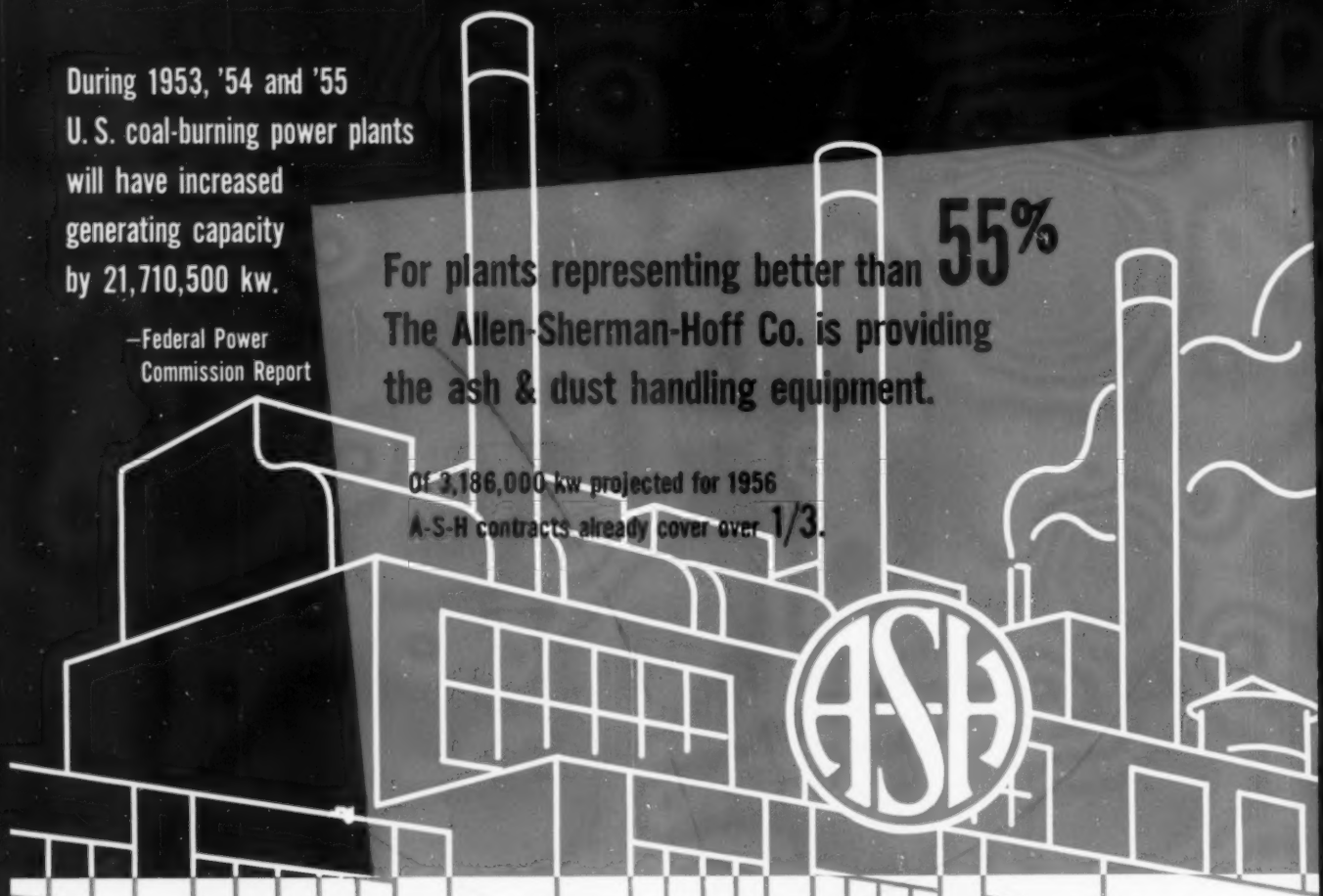
A McGRAW-HILL PUBLICATION

HEAT EXCHANGERS: a 32-page handbook

3-YEAR NATIONAL PROJECTION OF GENERATING CAPACITY

During 1953, '54 and '55
U. S. coal-burning power plants
will have increased
generating capacity
by 21,710,500 kw.

—Federal Power
Commission Report


For plants representing better than 55%
The Allen-Sherman-Hoff Co. is providing
the ash & dust handling equipment.
Of 2,186,000 kw projected for 1956
A-S-H contracts already cover over 1/3.
A-S-H

Why this vast participation

Having pioneered in ash & dust handling development and having collaborated with hundreds of power-plant engineers, A-S-H brings to each new problem a fund of experience that is without parallel. Ideas projected on our drawing boards at Wynnewood and tested in our equipment-manufacturing plant at Hamburg, Pa., will help you get what you want for your plant—increased efficiency with economy.

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materials handling systems

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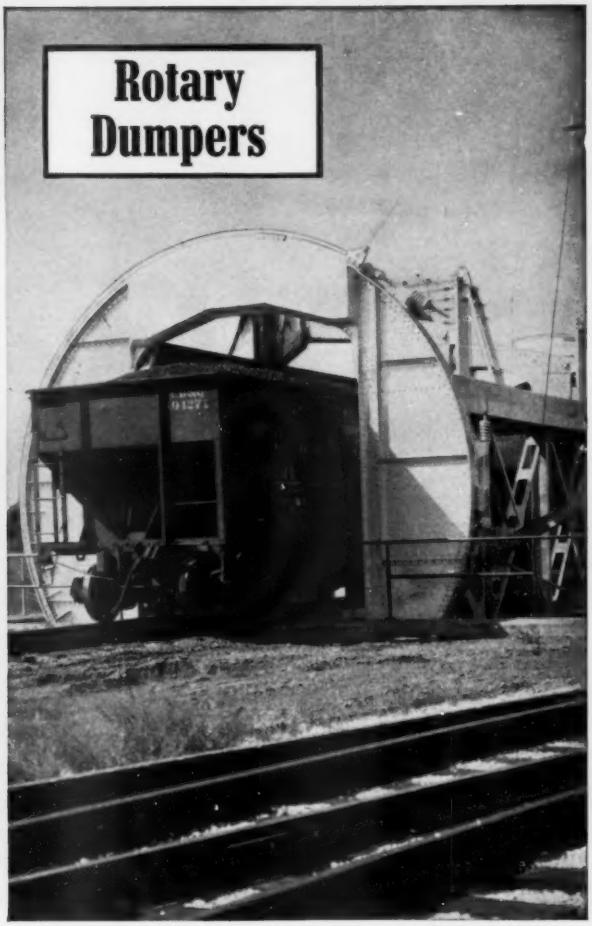

BOTTOMS UP . . . empties 90-ton car every 60 seconds or less (including return to upright position) by simply turning car upside down. Simple, automatic, foolproof. Takes all open-type cars—any length, width or height . . . up to 90-ton or 120-ton capacity. Book 2048-A has complete data.

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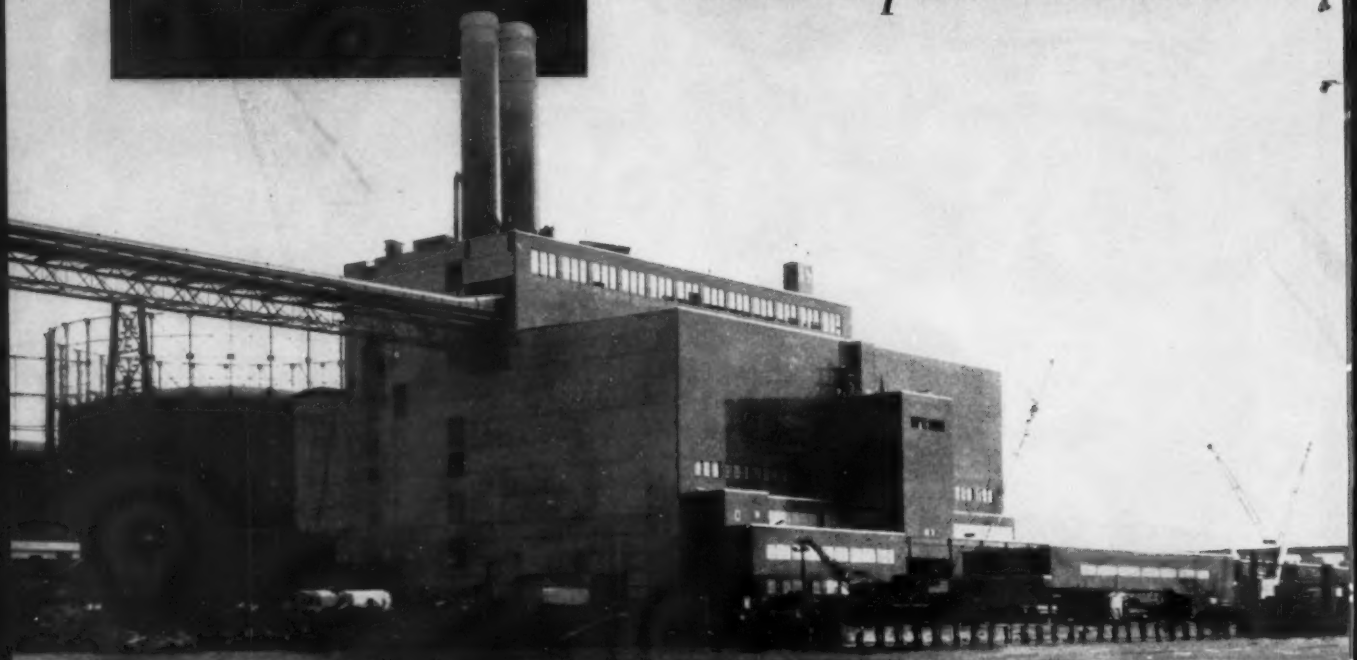
DE LAVAL

BARREL TYPE
BOILER FEED PUMP

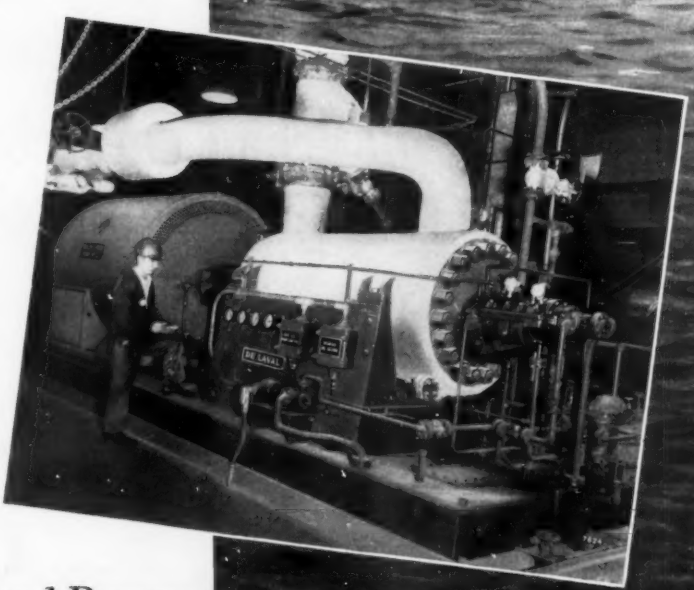
in new Con Edison *Astoria power station*



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.

The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches.

De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.



DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL 255

Power

JUNE 1954 • VOLUME 98 NUMBER 6

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

126 MILLION DOLLARS were saved in '53 by using feedwater heaters. To maintain efficiency these units must be taken apart, sometimes yearly, and inspected for scale, pitting, cracks and leaks.

It was just such an inspection that artist Kent Day Coes "stopped" in water colors on this month's cover. Working up an art cover is generally a 3-way cooperative job involving artist, POWER's Art Editor Charlie Marschalek, and the engineer-editor closest to the subject being painted. This month, Ben Skrotzki and Tod Waldron kept a watchful eye on its progress since they authored the 32-p handbook on Heat Exchangers, p 75.

About that 126-million-dollar saving. We arrive at that figure by assuming a 13% fuel saving where feedwater heaters are used. Checking coal-consumption statistics for '53, we get a 21-million-ton saving. And at $6 a ton, you get the 126 million.

Next month . . .

- A nuclear-energy study course gets under way, authored by Henry Schwenk and Bob Shannon of the Dow-Detroit Edison group. Having sweated through the transition themselves, they're aiming to give other engineers the low-down needed to understand physicist's lingo, cope with new problems of atomics.

- Steam or diesel? July issue will carry the first of a 2-part article giving a run-down on economics of generating units of 16,500 kw or less.

- Since innovation of the mixed-bed deionizer as a demineralizer, its advantages have been much discussed. An upcoming article gives some of the answers.

- Hydraulic lifts are staging a comeback, but with oil, not water. Look for a "double-header" describing unit controls, and modern hydraulic oils.

. . . and future months

- POWER's report on "Today's Electrical Practice" (October 1953) pointed out two distinct trends in industrial plant electrical-distribution practices: (1) use of higher voltages (2) adoption of the load-center technique. The new Alcoa plant in Lancaster, Pa. distributes at low voltage, without load-centering; and has some good reasons for so doing. Watch for this article in August.

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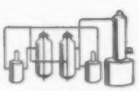
Demineralizers

Reactors

Continuous Blow-Off

Specialties

C-B Systems

Power

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...with Power readers...

THE STEAM TURBINE IN 1896

I'm sending some 1896 *Power* sheets picked up in an abandoned assay office in the hills. . . . I had a pleasant hour with them.

Pueblo, Colo. BILL SHAFER

ED. NOTE: *In thumbing through these tattered pages we noticed an editorial item that chronicled the times and pinned down some long-range predicting.*

"The steam turbine is attracting the attention of engineers to a growing extent, and reports come from abroad of really surprising results. At the Bordeaux Exhibition, a hundred horsepower De Laval turbine ran on 21 pounds of steam per hour per horsepower on a seven hour test, with 113 pounds initial pressure and 26 inches of vacuum. . . . When it is remembered that these are brake, not indicated horsepower, it will be recognized that these performances more than equal recorded values for multiple condensing engines of same power.

"These efficiencies increase with the size and power. If it shall transpire upon repeated test and with continuous use that this type of motor can attain and maintain such duties as these without betraying serious disadvantages it will make a serious rival for the piston engine, . . . it is much lighter for the same power, compact and extremely simple."

...lines and bylines

Waldron, *left*, and Skrotzki get together on *Power's* latest handbook

CLOSE TEAMWORK was in evidence all through the many months of preparing POWER's handbook on Heat Exchangers, see p 75 of this issue. Associate Editor Ben Skrotzki lined up his strong central-station savvy alongside the Navy engineering-officer skills of Assistant Editor Tod Waldron to design and write this latest of the ever-popular POWER handbooks.

In contributing to this heat-exchanger section, Tod Waldron successfully carried out his first major editorial excursion. At the same time he was also rounding out credits at Columbia University, for an engineering master's degree, at night, plus locating a house in Ridgewood, New Jersey, for his sizable family.

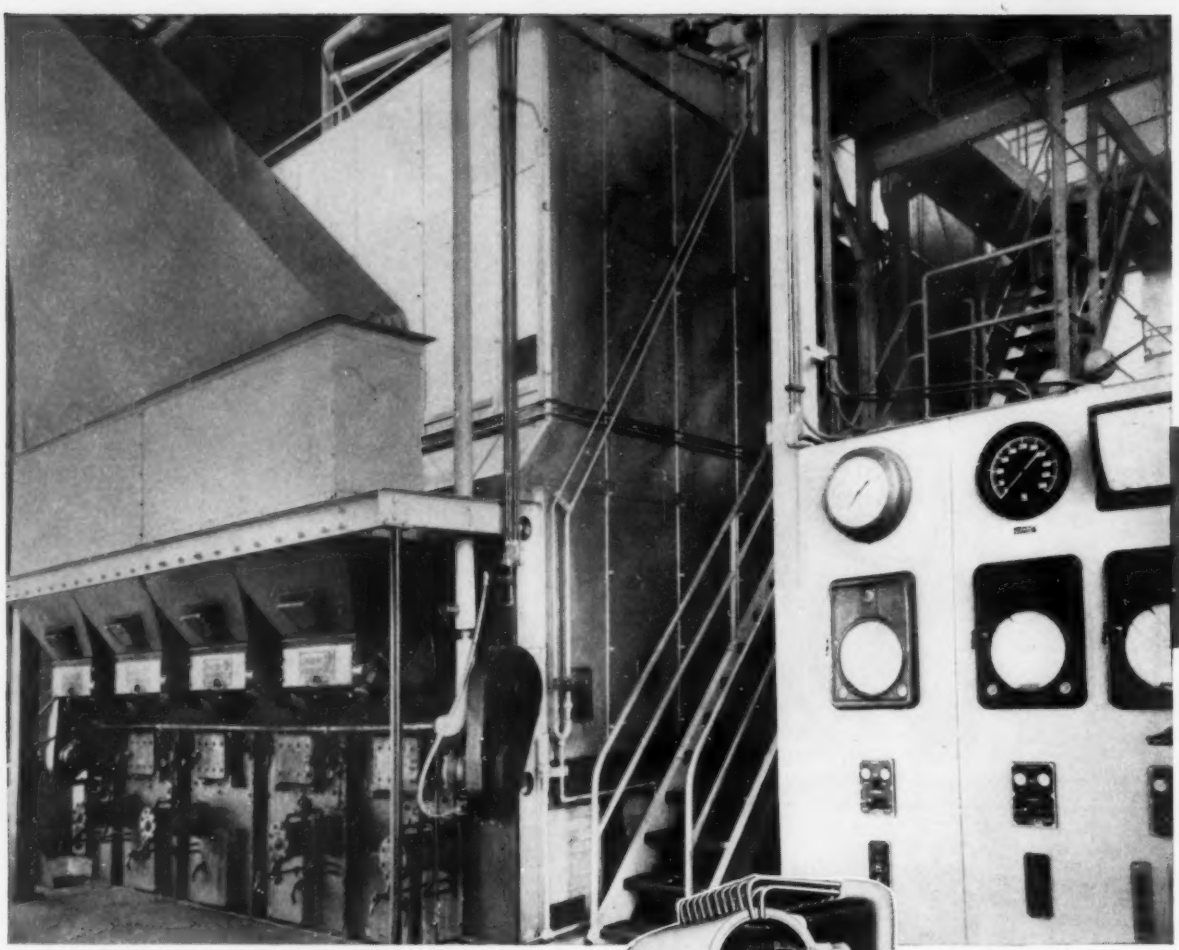
You readers will spot Skrotzki's fine hand behind the many 3-dimensional drawings. Incidentally, this skill in simplifying engineering theory is apparently heritable. At least we felt so when high-schooler Paul Skrotzki dropped in to see his dad while toting a cleverly designed model to demonstrate molecular heat motion. The rig had red balls (molecules) floating with the aid of rubber bands in crystalline-like structural formation. The balls were set quivering by a simple vibrator, simulating molecular motion in heat conduction. Young Skrotzki's model copped first prize in a regional science contest.

Morris Brenner

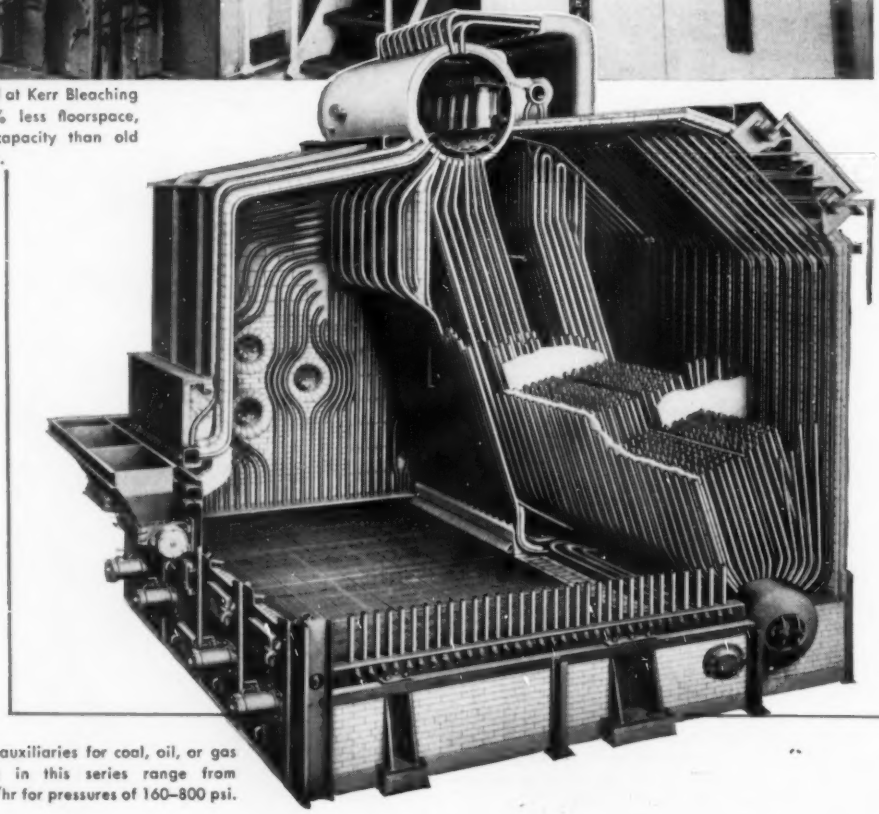
ELECTRICAL CONNECTORS have been close to Morris Brenner ever since he received his BEE from New York U in '46. Now as supervisor of a design-liaison group with Burndy Engineering Co, Morris solves customer-engineering problems. He authored the article starting on p 124.

Both Eta Kappa Nu (electrical engineering honorary) and AIEE make bids for Brenner's spare hours. He is past president of the Eta Kappa Nu, N. Y. Alumni Chapter and an active committeeman in AIEE. His byline has appeared above many engineering articles.

Although born and raised in New York City, Morris is now what he calls a "reverse commuter." This came about after Burndy Company moved from New York to Norwalk, Conn. He likes his present travel pattern and will quickly outline for you some of the many benefits of always going opposite to the daily commuter stream in and out of the big city. In hours off the job, Morris has two prime interests: his wife and an active 2½-year-old son. But he also finds time for some pleasant hours with hi-fi, science fiction, keeping up with the house.



B&W Integral-Furnace Boiler, Type F J at Kerr Bleaching and Finishing Works, required 46% less floorspace, yet delivered 50% higher steam capacity than old installation of nine separate boilers.



Type F J unit and auxiliaries for coal, oil, or gas firing. Capacities in this series range from 30,000–70,000 lb/hr for pressures of 160–800 psi.

G-486

WHAT HAPPENED...

When 1 New B&W Integral-Furnace Boiler Replaced 9 Old Boilers...

... at

KERR BLEACHING *and* FINISHING WORKS

When this Concord, N. C. Company found their nine old boilers were not yielding adequate steam to maintain steady production, they commissioned A. G. Odell, Jr. and Associates to design a building to house a brand new steam plant. And to insure a constant and dependable process steam supply under demands that varied from 28,000 to 73,000 pounds per hour . . . with swings as wide as 16,000 pounds per hour . . . Kerr engineers selected a single B&W Integral-Furnace Boiler, Type FJ, 250 psi, 60,000 lb/hr continuous and 70,000 lb/hr peak load on coal, oil, or gas.

Performance over the three-year period since the change from "Nine to One" more than substantiated the confidence placed in this B&W unit . . . and, just as important, contributed far-reaching economies. Fuel, payroll and maintenance charges were cut sharply . . . savings on fuel alone amount to more than $90,000 a year. Valuable floorspace was released for additional production facilities. *And* . . . with a reliable, ample steam supply available, orders are being scheduled more accurately, while production quality and quantity have reached new highs.

Complete satisfaction with the continuing performance of this unit—even under load conditions exceeding design specifications—was indicated when this company recently installed another B&W Integral-Furnace Boiler, Type FJ. To quote Mr. W. Hunt Fisher, Plant Engineer of Kerr Bleaching, "On the basis of what our present unit has done for us, I am confident that we could not have made a wiser choice for our new one."

To the hundreds of other users of B&W Integral-Furnace Boilers, their economical installation, maintenance, and operation are an old story. (Units producing a total of over 200,000,000 pounds of steam per hour are in service and on order for almost every variety of industry, plant or institution.) If *you* have problems in steam supply for processing, power, or heating, B&W's more than 70 years' experience in boiler construction and application will interest both your plant engineers and cost accountants. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

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- Easy to inspect and clean
- High availability with least attention

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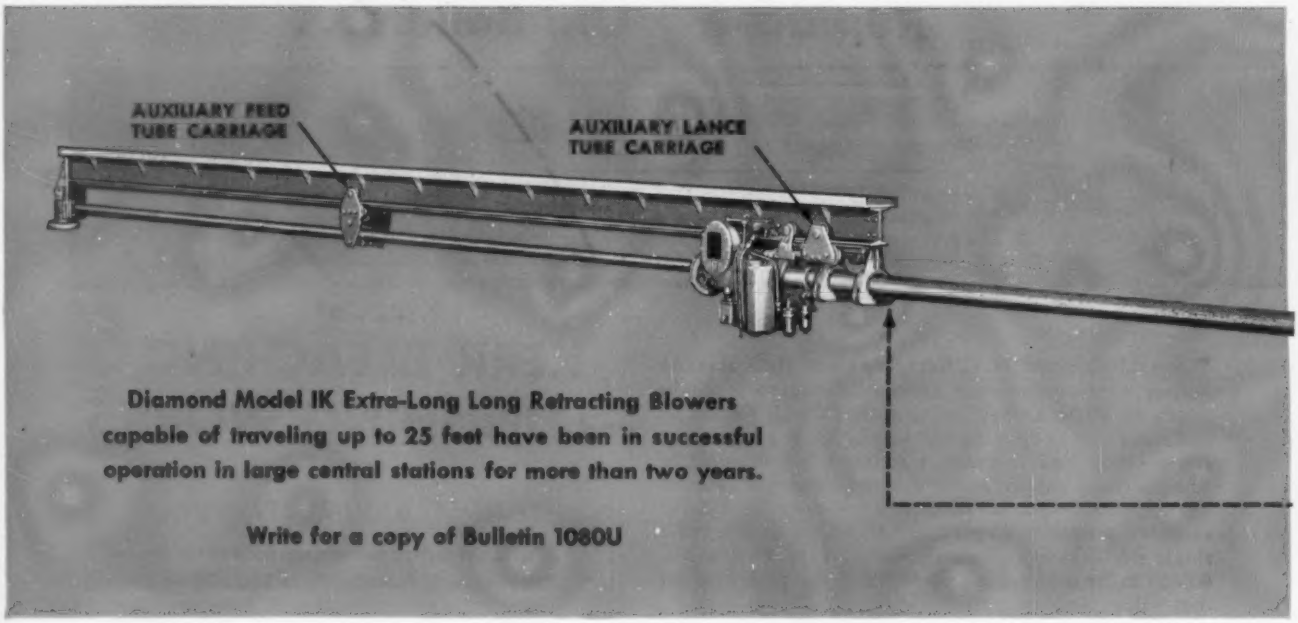
Long Retracting Blowers . . .



Diamond Model IK Extra-Long Long Retracting Blowers capable of traveling up to 25 feet have been in successful operation in large central stations for more than two years.

Write for a copy of Bulletin 1080U

For correct tube cleaning in extremely wide furnaces, Diamond uses the Model IK Blower with auxiliary lance and feed tube supports and with increased power (either electric or air motor). There is a moving carriage that provides intermediate support for the feed tube while the blower is operating, and a second moving carriage that provides intermediate support for the lance tube in the retracted position. Positioning of these two auxiliary carriages is automatically synchronized with movement of blower.

This Diamond development makes it possible to correctly clean tube banks in furnaces of greater widths than was previously possible with any retracting soot blowers on the market. There are other Diamond developments now undergoing tests that will also contribute to the advancement of boiler cleaning practices . . . particularly for very wide high-capacity units.

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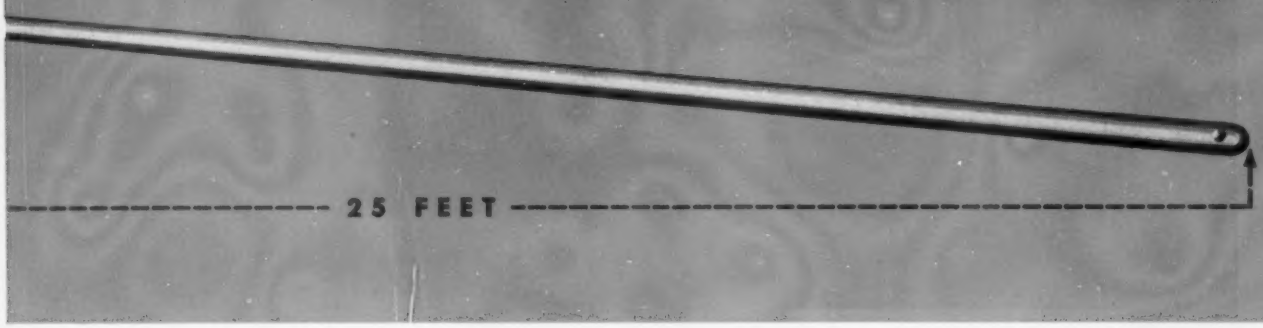
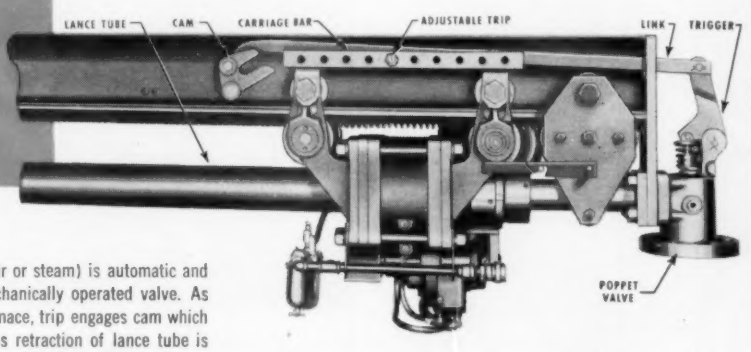
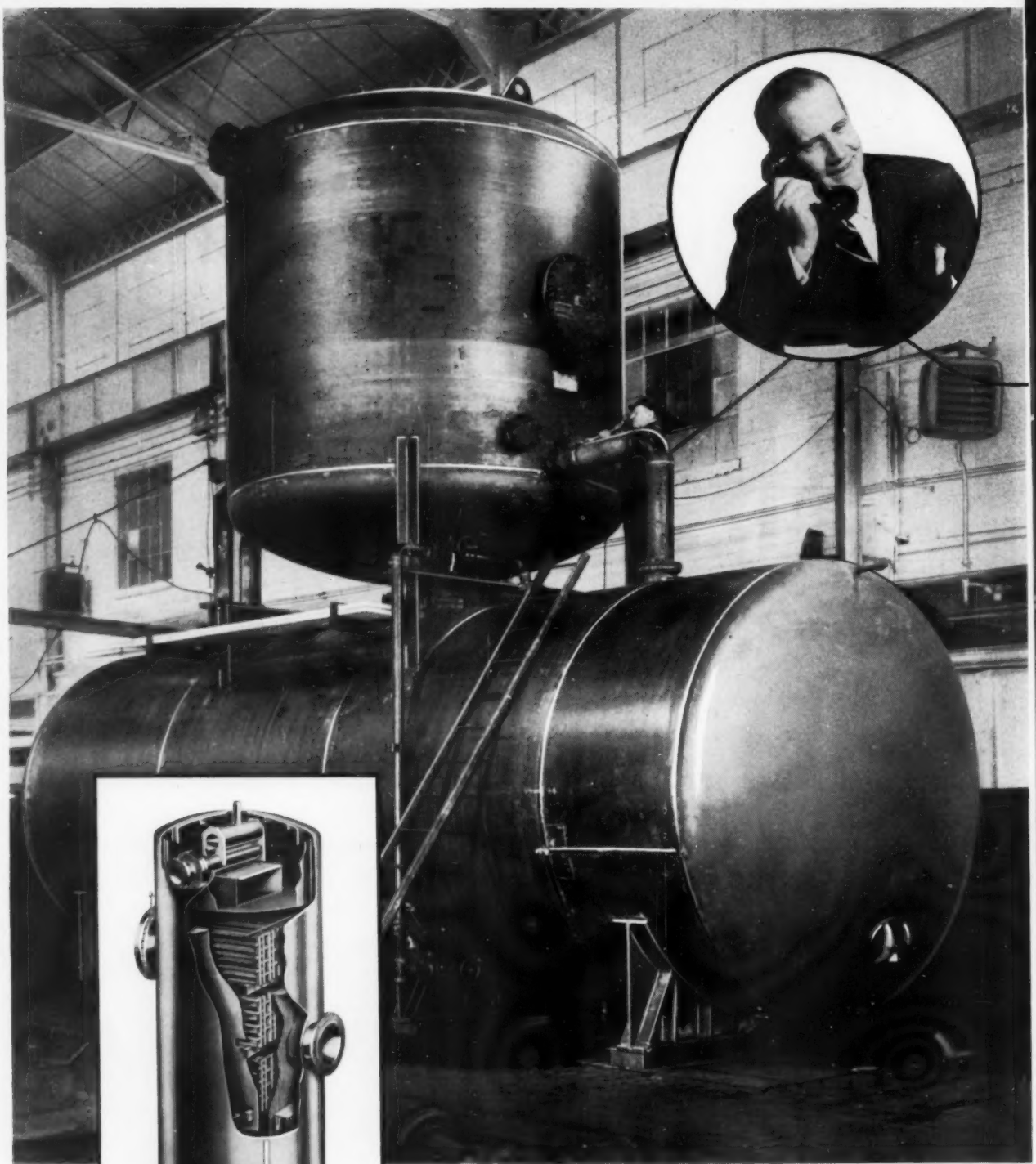


Mechanically Operated Valve



Control of the blowing medium (air or steam) is automatic and accurate by means of a simple mechanically operated valve. As lance tube begins movement into furnace, trip engages cam which actuates valve through a linkage. As retraction of lance tube is completed, trip reverses movement of cam, closing the valve.

Important advantages: (1) positive valve action (2) adjustable valve operating position (3) low pressure drop (4) completely adaptable to steam and air blowing interchangeably (5) no critical adjustment for tight valve seating (6) adjustable pressure control on each individual blower.



A 1,000,000-lb-per-hr deaerating feedwater heater mounted on its storage tank, just after passing its hydrostatic test in the Elliott shops. This is one of six similar units for an important utility.

◀ The latest design Elliott tray-type deaerating heater. This one is the multiple tray compartment type, designed to deliver water with commercial zero oxygen content.

N4-1

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ON-THE-SPOT FIELD SERVICE

In discussing deaeration problems with your Elliott sales engineer, you are getting the cooperation of an expert, factory-trained from the ground up in every aspect of deaeration, familiar with its principles as established step by step from Elliott's first pioneering unit of a generation ago, to the present space-saving, easily serviced design.

But that isn't all —

Spotted in strategically selected centers all over the country, are a corps of Elliott field service men, thoroughly capable in the diagnosing of operating difficulties and in their correction.

Beyond this, trained personnel in the home shops in Jeannette, Pennsylvania, stand ready when needed to travel to a trouble-spot as fast as the swiftest airplane can get them there.

So — when it's a deaeration problem, either a projected installation or the servicing of one already operating, pick up the phone and call your Elliott sales engineer. Or if more convenient write or wire Elliott Company, Deaerator and Heater Department, Jeannette, Pa.

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How to the Efficiency Boiler-Room

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

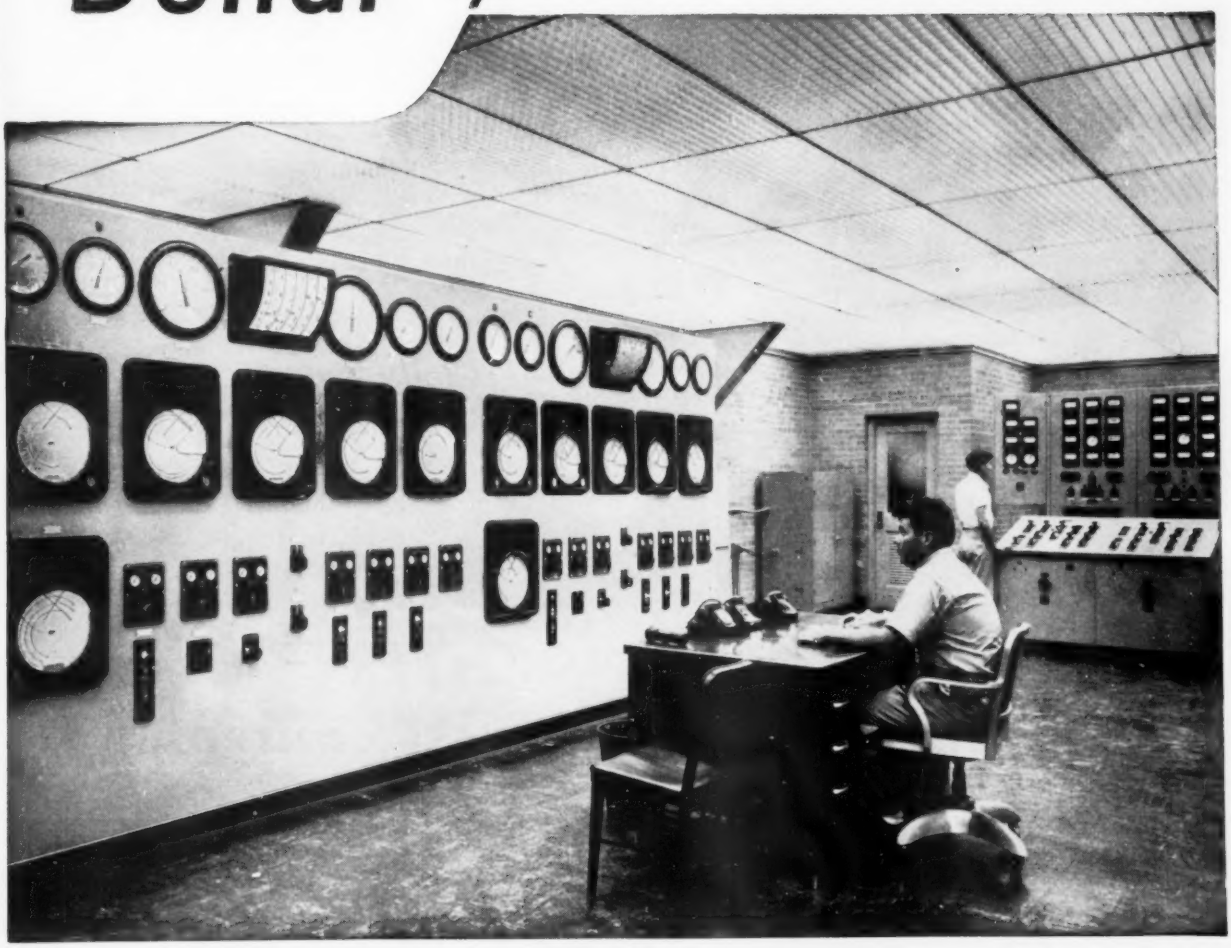
For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

m-1

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

INCREASE of YOUR Dollar



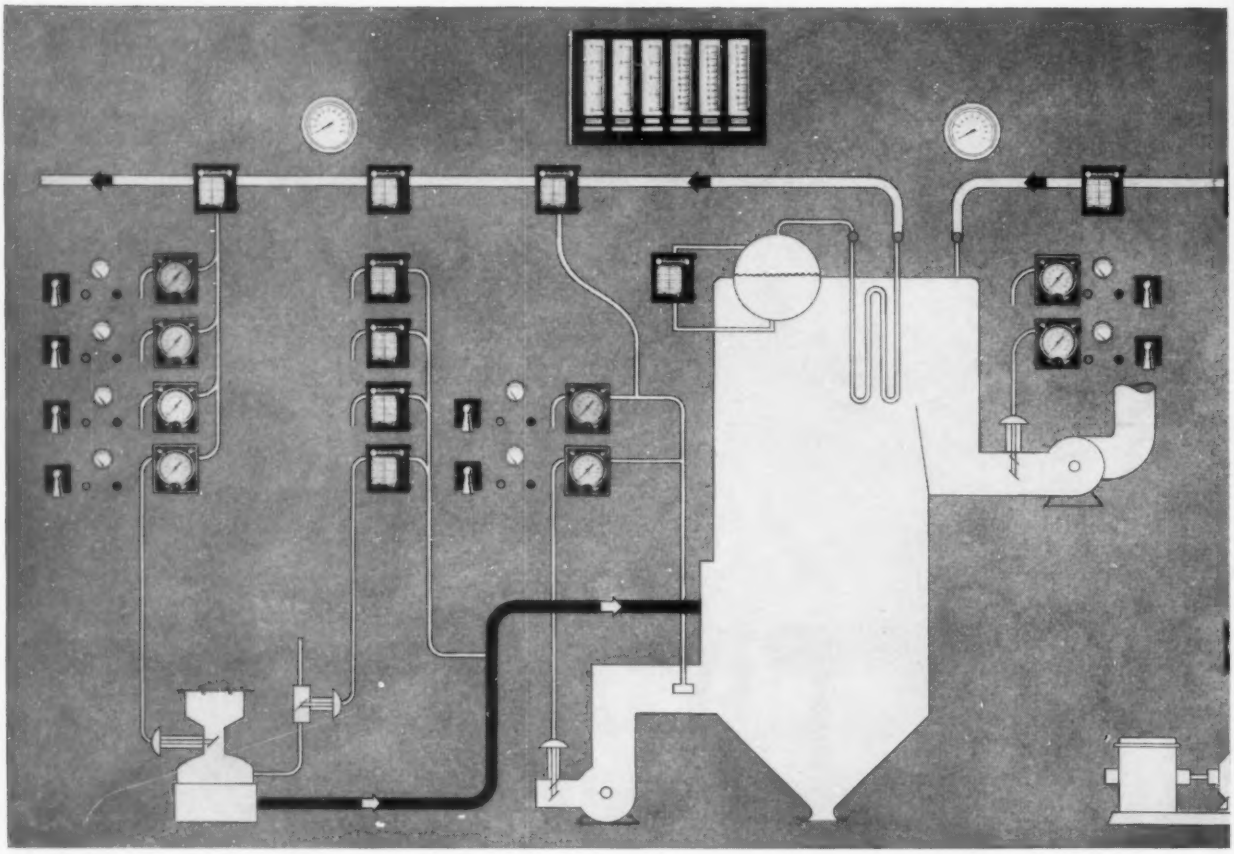
These Bailey Boiler Controls for Combustion, Feed Water, and Steam Temperature insure efficient operation of two 450,000 lb per hr, 1000 psi, 900 F, gas and oil fired boilers.

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA

TO REDUCE



COPES-VULCAN OFFERS ALL THESE CONTROLS

COMBUSTION

Combustion may be controlled from steam flow-air flow, or by fuel-air-ratio method. Instrumentation of the most modern design by Taylor assures fast response, accurate control and utmost dependability.

FEED WATER

Boiler Feed Water may be co..trolled from three, two or one influences. Feed water control systems may have *instrumentation by Taylor* (Type 3-L, Bulletin 1013), or be electrically or mechanically operated.

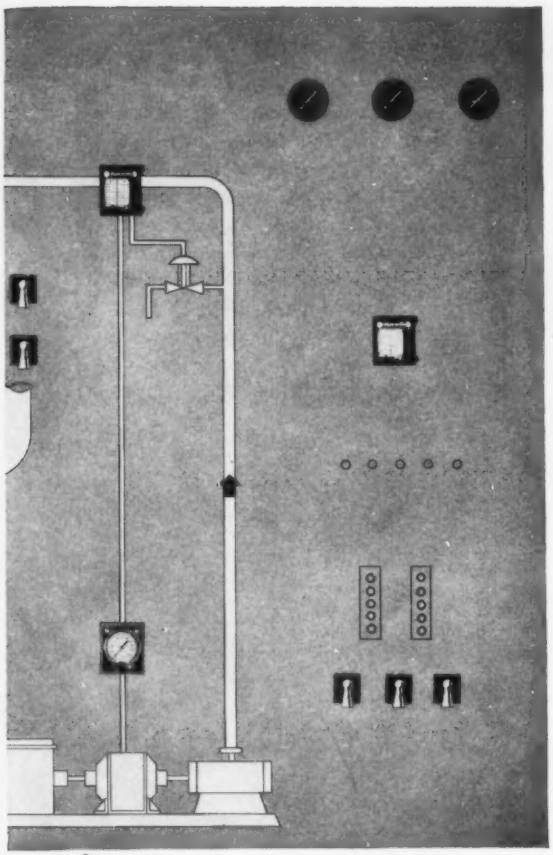
PRESSURE AND TEMPERATURE CONTROL

Pressure reducing valves to meet any need. Steam temperature control may be from three or two influences, using burner or damper positioning, gas recirculation, direct water spray or heat exchanger.

SOOT BLOWING

Full automatic-sequential control may be part of main panel or set up on separate panel. Individual push button control available. For smaller boilers there are manually operated units in several types.

STEAM COSTS



*Modernize With *C·V+T Boiler Control

WHEN you plan to modernize your power facilities, check into the many advantages offered by Copes-Vulcan Boiler Control.

From one dependable source, you can get modern combustion control *with instrumentation by Taylor*, precise feed water control, accurate steam temperature control and automatic cleaning of heat-transfer surfaces.

Remember, too, Copes-Vulcan assumes full responsibility for service wherever needed—for the life of your installation.

Ask Copes-Vulcan engineers for recommendations on how to reduce your steam costs. Write for Bulletin 1007-A.

*C·V+T=BBC

COPES·VULCAN+*Taylor*=BETTER BOILER CONTROL

COPES-VULCAN DIVISION

CONTINENTAL FOUNDRY & MACHINE COMPANY

ERIE 4, PENNSYLVANIA

COPES VULCAN BOILER CONTROL

WITH INSTRUMENTATION BY *Taylor*

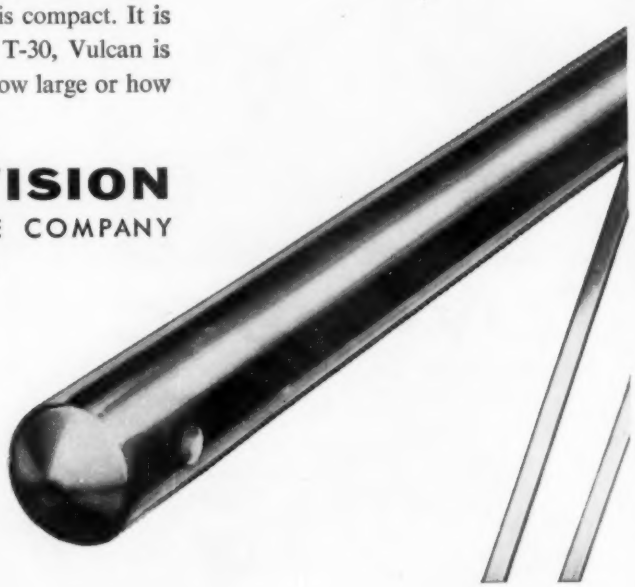
"Build us a Long Retract . . .

this was the problem

Designers have talked of boilers 60 or more feet wide, but it had seemed impossible to clean them. Now this problem has been solved by the Vulcan long retract shown at the right. With two entering the furnace from opposite sides, boilers larger than have ever been built can be cleaned dependably.

THIS Vulcan long retractable soot blower has been thoroughly tested. It has dual electric-motor drive. It has the double-helix cleaning pattern that has made Vulcan the standard for effective cleaning of furnaces up to 50 feet wide. Yet, for all its length, it is compact. It is easy to install, operate and maintain. With this new T-30, Vulcan is ready to clean your most modern boilers, no matter how large or how small they might be.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA



VULCAN Automatic

. . and we do mean Long"

VULCAN
KNOW-HOW
COSTS MORE
—But is Worth it

LOOK WHAT'S HAPPENING TO BOILER WATER GAGES.

● There's a "new look" in water gages for high pressure boilers. You'll find it in every new YARWAY Flat Glass Boiler Water Level Gage.

YARWAY design and development engineers have made *twelve distinctive improvements* in YARWAY gages. All contribute to improved water gage service, longer water gage life.

Better Illumination—improved mercury vapor illumination makes meniscus "shine like a star".

Body Improvements—flanged connections and expansion bends eliminate stuffing boxes and *prevent distortion*—separated design in four-glass inserts permit freedom for expansion—stainless steel facing for gasket recess provides corrosion proof surface for the higher pressures—close machining tolerances insure top quality.

Improved Gaskets and Mica—"Frelon" gaskets are coated with a special compound to prevent sticking at disassembly—wire inserts for the higher pressures give "Frelon" gaskets greater strength—thicker mica for the higher pressure gages.

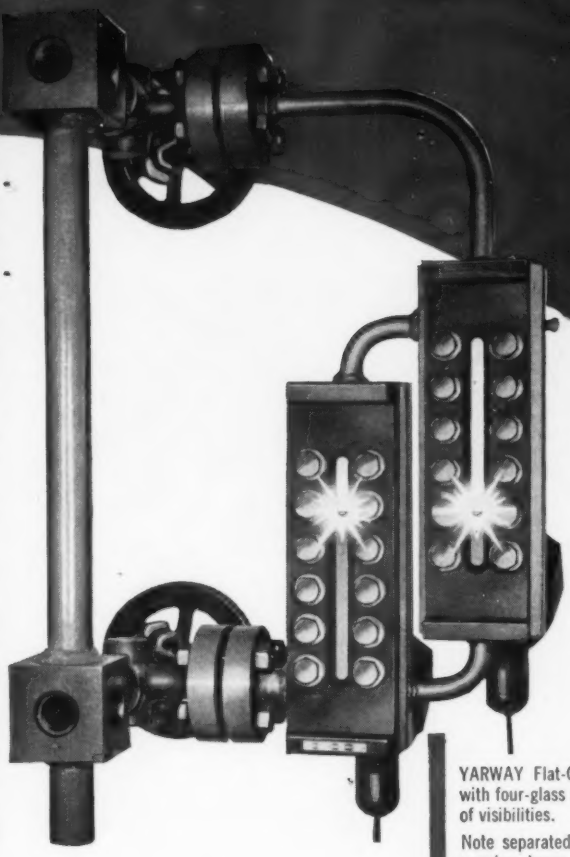
"Floating Assembly" Covers—improved capscrews have wider shoulders at face of body—improved spring cones reduce spring cone stresses.

Better Valves—YARWAY Welbond gage valves have integral stellite seats and stainless steel stems—Welbond water column shut-off valves have lock-open device.

YARWAY Gages are the "gages to see" on all new boiler units or replacements in high-pressure installations.

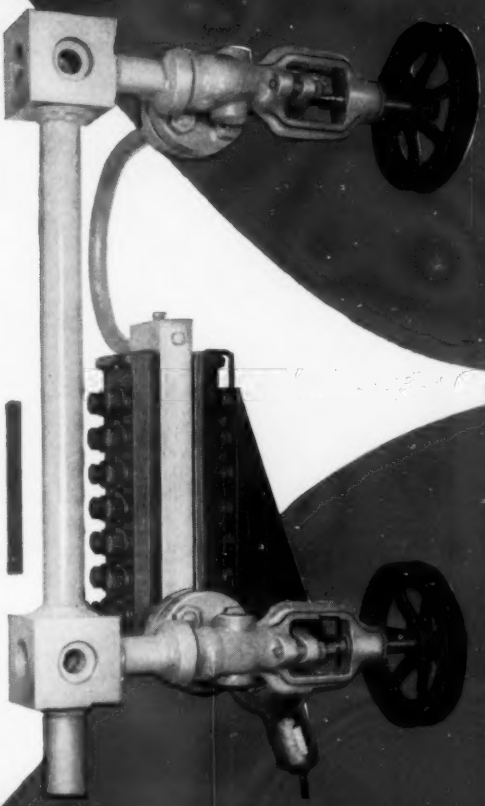
Write now for new YARWAY Bulletin WG-1812.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

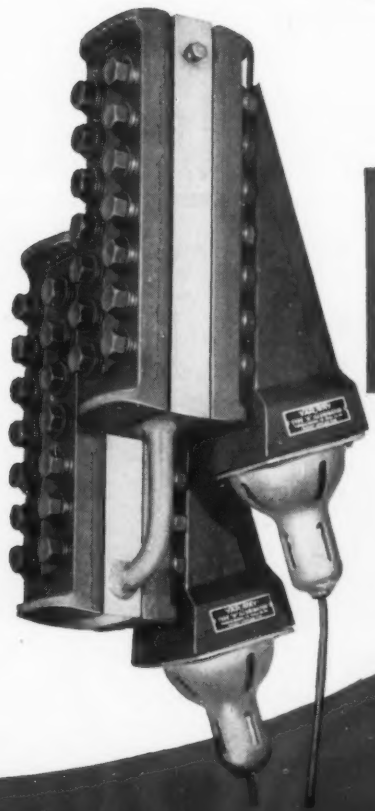


YARWAY Flat-Glass Water Gage Assembly with four-glass double insert for long ranges of visibilities.

Note separated design, interconnecting expansion loops, flanged connections (1½" tie-bar-type circulating water column) and Type "M" Illuminators that make meniscus at water level "shine like a star".



YARWAY Single Insert type gage for medium range of visibilities. Note expansion loop and flanged connections. YARWAY Welbond Gage Valves assure highest dependability in high-pressure service.

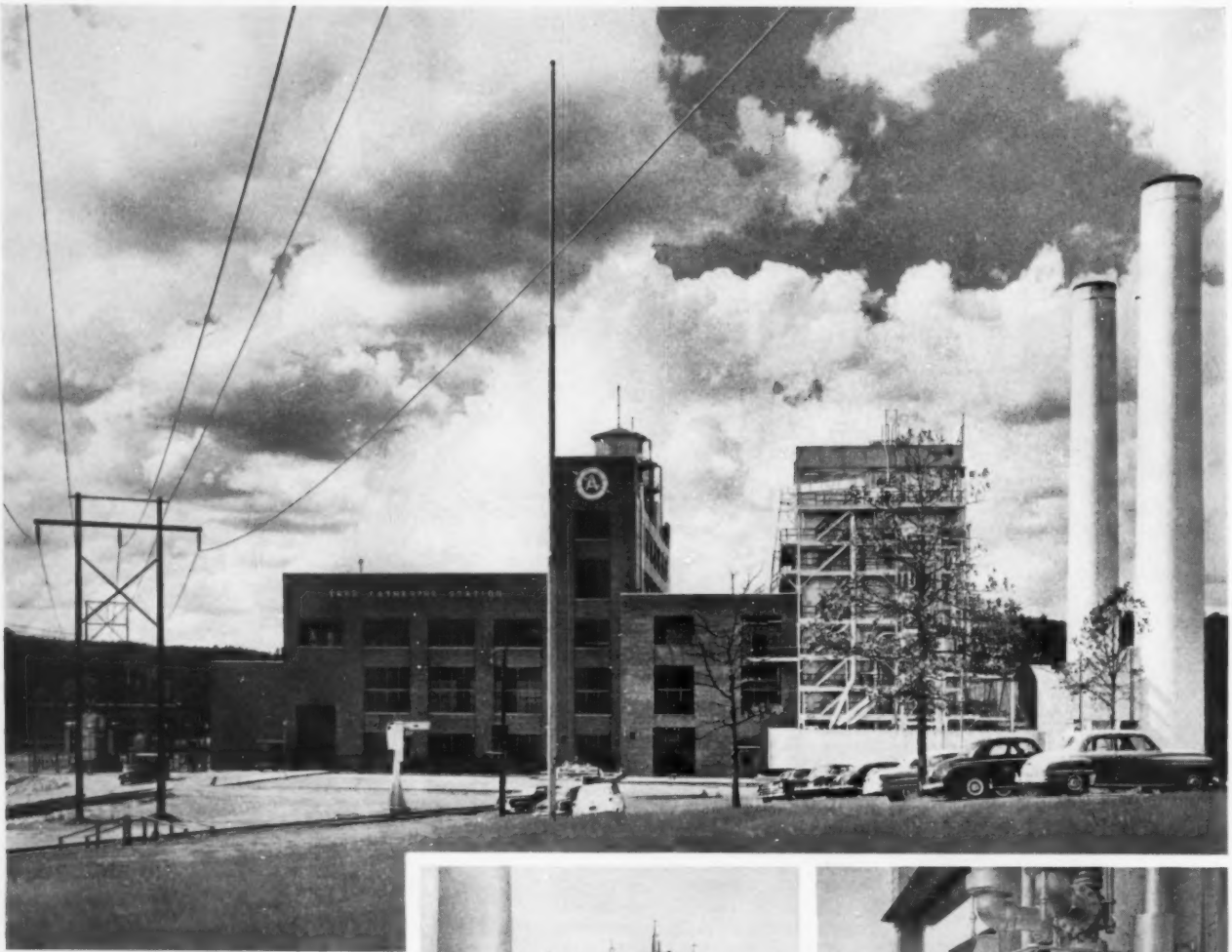


Close-up of YARWAY Type "M" Illuminators on above 4-glass insert assembly. The blue-white illumination is visible for distances up to 125 ft. and is especially effective in penetrating deposits on gage glasses, dust particles in the air and extraneous light.

YARWAY

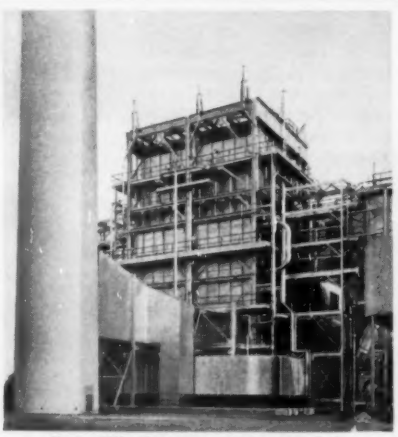
water columns and gages

FOUR MORE OUTDOOR

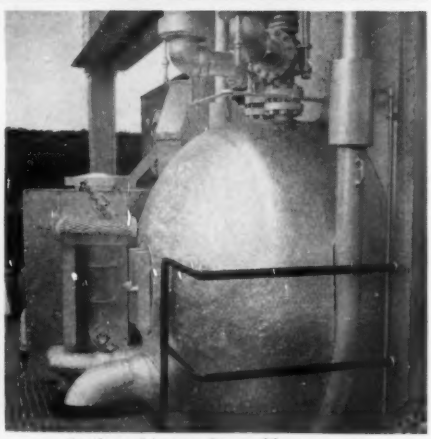


Lake Catherine Station of the Arkansas Power and Light Company.

All Units
Engineered By:
EBASCO SERVICES INC.



Foster Wheeler steam generator of the outdoor-type installed at the Arkansas Power and Light Company. Typical of those installed at Louisiana Power and Light Company, and Mississippi Power and Light Company.



Section of steam drum with external weatherproof covering protruding through water-tight, air-tight steam generator casing.

STEAM GENERATORS!

Foster Wheeler outdoor-type steam generators, each of 900,000 lb per hr capacity, now serving

Lake Catherine Station.....1 unit
ARKANSAS POWER AND LIGHT COMPANY

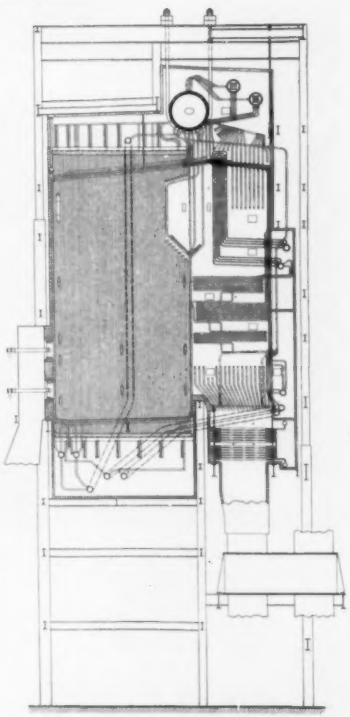
Ninemile Point Steam Electric Generating Station.....1 unit
LOUISIANA POWER & LIGHT COMPANY

Delta Steam Electric Station.....2 units
MISSISSIPPI POWER AND LIGHT COMPANY

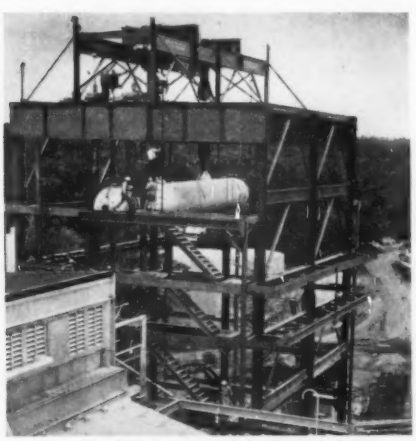
Reflecting the wide acceptance of the outdoor-type steam generator, these four Foster Wheeler units are all serving power plants in the South. Because of the traditionally mild climate in these areas, the minimum of weather protection is required for personnel, steam generating units and auxiliaries. This same basic design has proved practical and economical in the Northern States, the only difference being in the extent of weather protection provided.

Each of these new steam generators has a capacity of 900,000 lb per hr continuously, and 950,000 lb per hr for an eight hour peak. Each delivers steam at 1550 psi and 1005F at the superheater outlet. A superheat control condenser maintains steam temperature constant over an operating range from 600,000 lb to 950,000 lb per hr.

Because of the proven economy and suitability of outdoor-type construction under a wide variety of climates, Foster Wheeler units, such as these, bring a new abundance of low-cost power to help promote the industrial growth of the regions they serve.



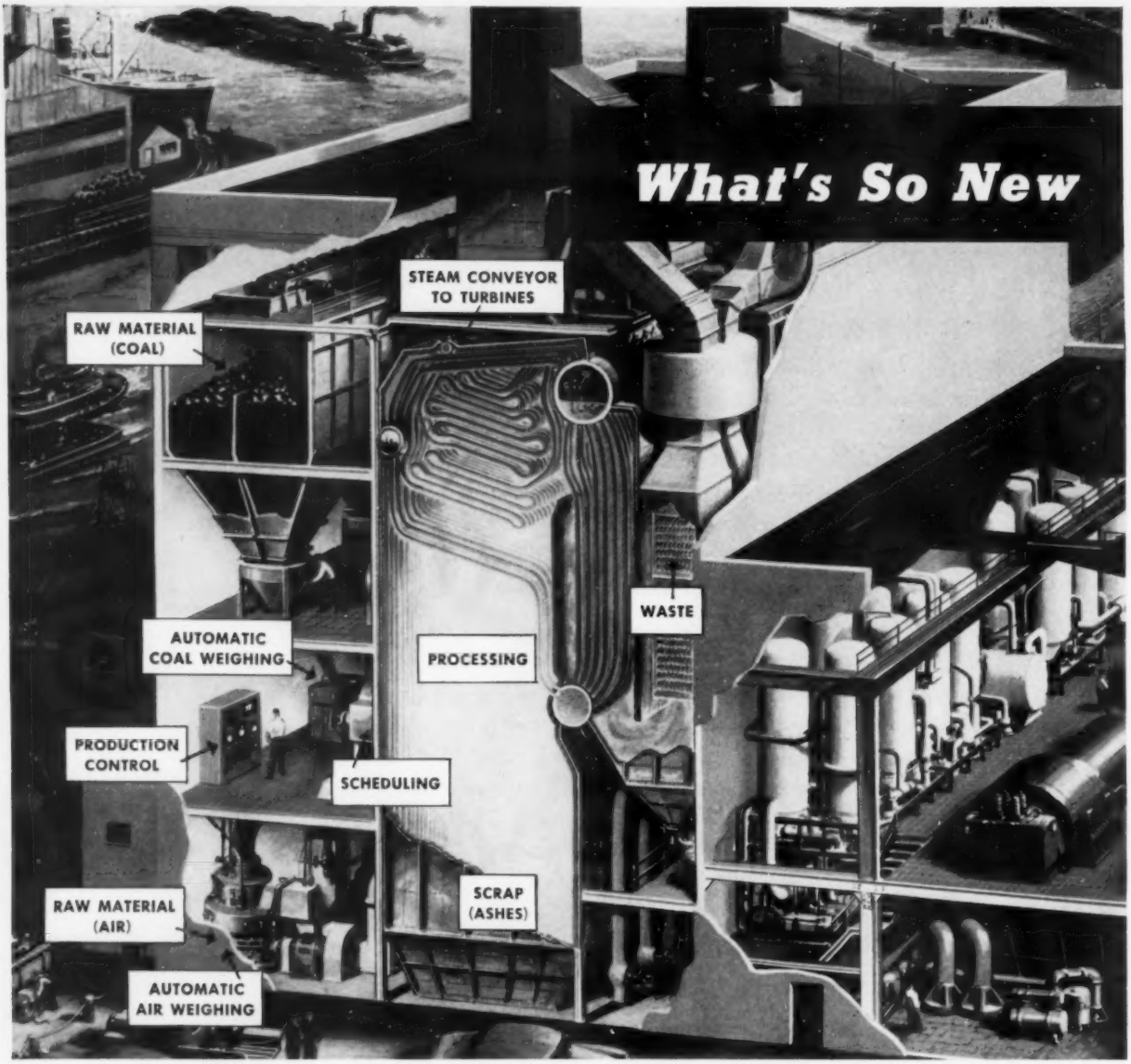
Cross-sectional elevation of the Foster Wheeler 900,000 lb per hr outdoor-type steam generator. Arrangement provides for modification of furnace for future pulverized coal firing.



The 145 ton drum of the Foster Wheeler outdoor-type steam generator being placed in position on structural steel framework at Lake Catherine Station.

FOSTER WHEELER

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



View Courtesy of the Armstrong Cork Company

This Is How a Factory Man Might Look at a Power Plant

That's because, in most plants, it's a completely automatic manufacturing operation, converting fuel and air into available heat and condensate and make-up water into steam for processes and turbine generators. Instruments and controls make it possible to achieve the full efficiency that has been built into the modern power plant.

REPUBLIC FLOW METERS CO.

About Automatic Factories?

. . . Power "Factories" Have Been Operated Automatically for Years!

THEY say it's coming — automatic production of automobiles, appliances and the thousands of other things we need and use. It's a startling thought, this idea of factories that will need only human supervision and maintenance and nothing more.

Yet, when you look at your own power plant, the idea doesn't seem so new after all. For power plants are actually factories. They produce products — steam and electricity — that are distributed, sold and used by millions daily.

PIONEERS OF AUTOMATIC FACTORIES

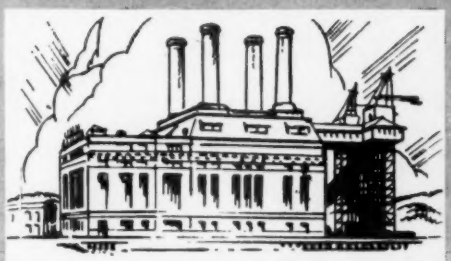
It is the power industry that has actually pioneered automatic factories. Almost 30 years ago the first power plant was operated entirely by automatic controls. Control principles learned from this and thousands of subsequent installations are guiding today's designers of the factories of tomorrow.

The Smoot Engineering Corporation, which made this first control installation, was acquired by Republic Flow Meters Co. some 20 years ago. Since then, Republic has carried on the Smoot leadership in the automatic operation of power plants, manufacturing a complete line of instruments and controls for this purpose. For example, a recent Republic development, the Electronic Telemaster, has made possible the control of large boilers where components are so distant that transmission lags in ordinary control systems would prohibit automatic operation.

With this wealth of past experience and an active development program to guide them, Republic engineers are able to give you the latest features in control systems to best meet your present and *future* needs.

REPUBLIC Automatic COMBUSTION CONTROLS

- For all types and sizes of boilers
- For all arrangements of draft
- For all types of fuel firing
- For all load conditions



SHERMAN CREEK STATION

WHERE AUTOMATIC POWER PLANT OPERATION WAS FIRST PROVED PRACTICAL . . . 30 YEARS AGO!

In 1922, Smoot Controls (now incorporated into the Republic line of instruments and controls) were installed on four boilers at New York's Sherman Creek Station in an experiment to test the feasability of controlling combustion automatically. Within five months, the superior performance of boilers with these controls was so conclusively demonstrated that the entire plant, consisting of 44 boilers, was equipped with Smoot Controls. After this test proved it was practical to control boilers with other machines, it was only a short time before automatic boiler controls were installed in scores of power plants all over the country.

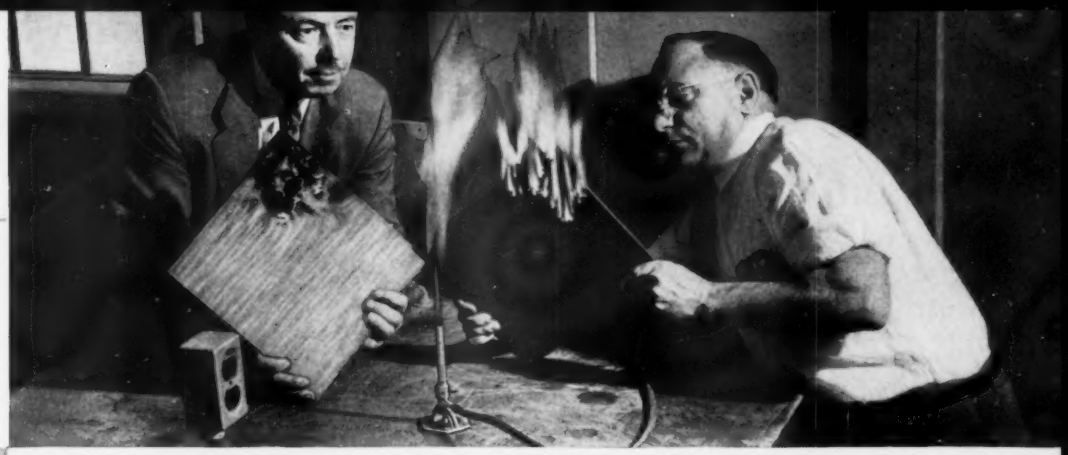
2240 Diversey Parkway • Chicago 47, Illinois

1951 GENERAL ELECTRIC INTRODUCES SELF-X, A NEW FLAME-RETARDANT INSULATION

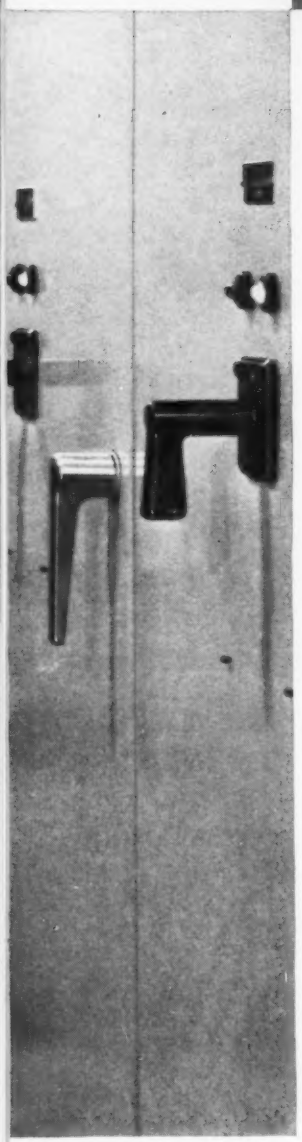
1954 SELF-X GUARDS OVER 10,000 GENERAL ELECTRIC METAL-CLAD UNITS

G-E METAL-CLAD SWITCHGEAR lineup features Self-X, G.E.'s service-proved flame-retardant insulation, at vital points.

COFFIN AWARD. Nicholas F. Arone, laboratory engineer in G-E Switchgear Product Laboratory, receives Company's highest employee honor—the coveted Coffin Award—from G. E. Burens, General Manager, Switchgear and Control Division, for developing Self-X insulation.



COMPARISON TEST shows why Self-X insulation gives better protection to metal-clad switchgear. In this photograph, taken immediately after both pieces of insulation were withdrawn from the flame, N. F. Arone (at right) holds a piece of ordinary insulation which continues to burn, while the Self-X held by H. F. Hentschel, General Manager—Medium Voltage Switchgear Department, stopped burning as soon as flame was removed. Other tests of Self-X included exposure to electric arc.



Self-X insulation proved by three years of service

Back in 1951, the first sheets of a new type of flame-retardant, self-extinguishing insulation, just developed by General Electric, were installed in a metal-clad switchgear unit.

In severe laboratory tests, the new Self-X insulation proved that it could stand up even under direct flame or an electric arc. As soon as direct flame contact was removed, polyvinylchlorides in the laminated sheets went to work *fast*. Smothering action started—and the fire was put out in less than a minute.

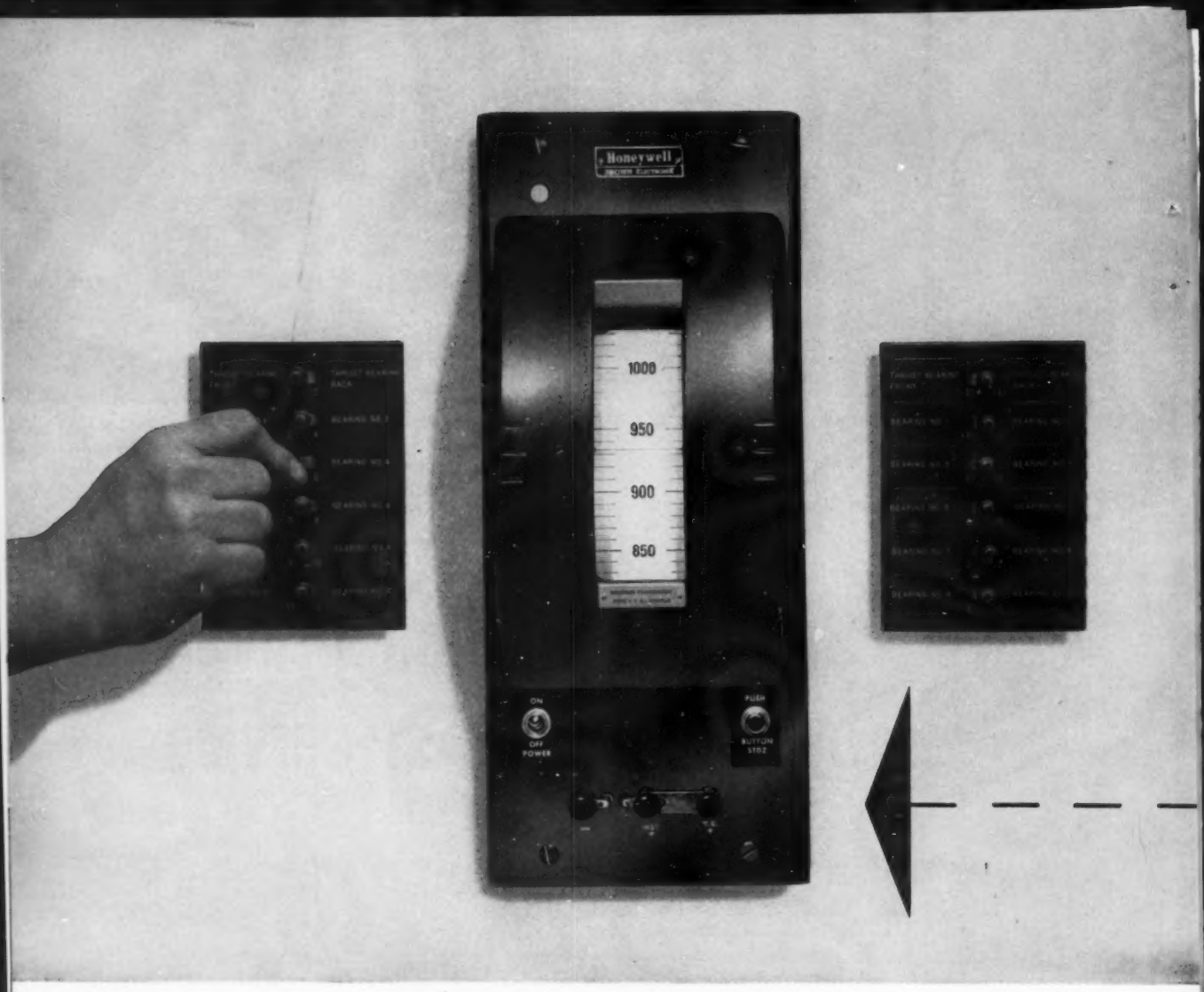
That was over three years ago. Today, this service-tested insulation developed by General Electric Company is acting as a built-in fire extinguisher for over 10,000 switchgear units. Its flame-retardant features make it ideal for bus and cable supports, insulating barriers, between compartments, box carriers for arc chutes—all vital spots.

Self-extinguishing insulation is just one of the advanced safety features of G-E Metal-Clad Switchgear, which helps guard utility and industrial power distribution systems. To learn more about it, call your nearest G-E Apparatus Sales Office or Authorized Agent. Or write for bulletin GEA-5664 to General Electric Company, Schenectady 5, N.Y.

511-4

Progress is our most important product

GENERAL ELECTRIC



Look at these features!

compact case
approximately 6½ inches wide by 15⅜ inches high

easily-read drum scale
rotates vertically; graduated length 28⅝ inches provides big, legible scale divisions and numerals.

accurate hairline index
eliminates parallax errors, permits high readability.

fast measurement
full scale rotation in 4½ or 12 seconds for 60-cycle operation.

external key switches
can be located at the side of the indicator (as shown), below or above—wherever most convenient for the particular panel layout.

large number of points
additional key switch banks provide any desired number of temperature points. Legend plates facilitate identification.

high precision
calibrated accuracy is 0.2% of scale span.

variety of ranges
supplied for use with either thermocouples or resistance thermometers, in a selection of ranges applicable to power plant temperatures.

Squeezed for panel space?

THIS NEW

Honeywell temperature indicator

needs no elbow room!

CROWDED PANELS are no problem for this new temperature instrument . . . the Vertical Scale Precision Indicator. Its slender, compact case makes it a natural for graphic panels—and a readily-inserted, space-saving member of conventional generator and turbine boards.

Basically, it's the same *ElectroniK* Precision Indicator which the power industry and many others have used and relied upon for many years. But, its outside appearance has changed: it's a completely new design that places the bulk of the instrument mechanism *behind* the panel . . . uses the valuable front-of-panel space primarily for the indicating scale.

Equipped with key switch banks, the Vertical Scale Precision Indicator offers a fast, convenient way to spot-check temperatures in bearings, pumps, hydraulic couplings, motors and other potential hot spots.

Your local Honeywell engineering representative will be glad to discuss how this new instrument can save space on the new panels which you may be planning. Call him today . . . he is as near as your phone.

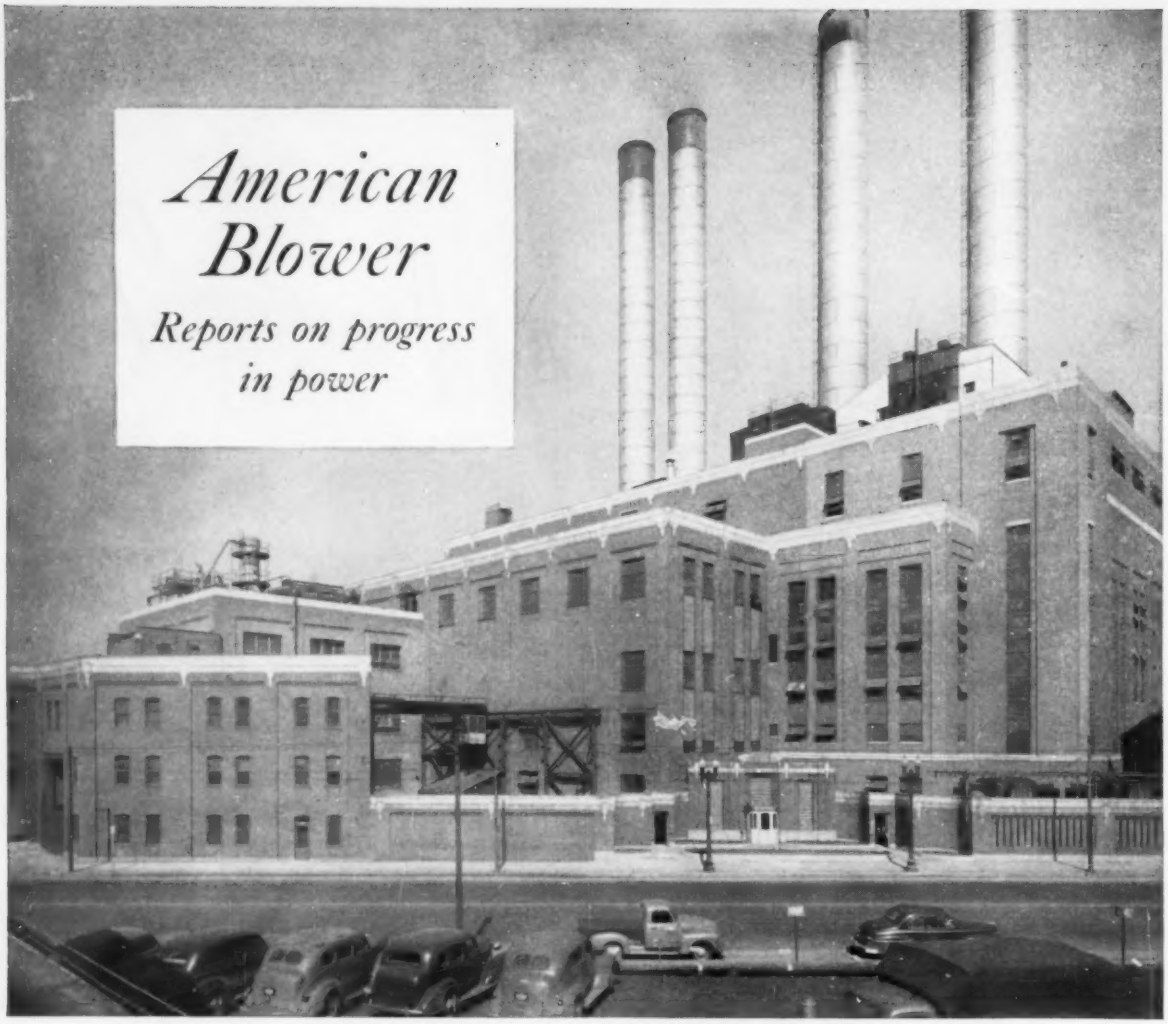
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin No. 1541 on the Vertical Scale Precision Indicator.**

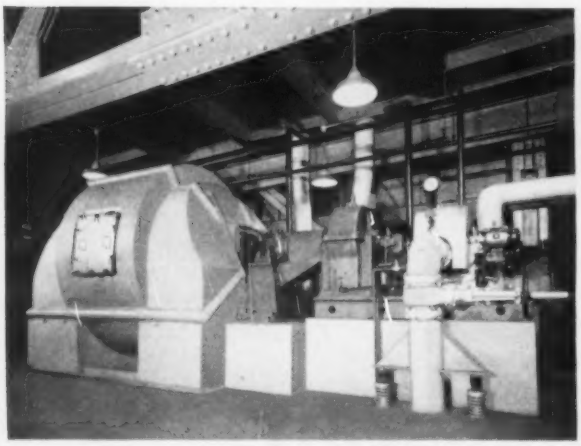
MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

American Blower

Reports on progress in power



Impressive Perry K Plant (above) has installed capacity of 1,900,000 lbs. of steam per hour. Indianapolis Power & Light Company has four other plants of which the White River Plant is newest and largest.



One of the American Blower Induced Draft Fans at the Indianapolis Power & Light Company's Perry K Plant. Rated at design point for 200,000 cfm at 620° F., 730 rpm, with 9" sp.

Looking at #15 boiler area at Perry K Plant, you see IP&LC's American Blower Dust Collectors before operation. Each is rated at design point for 200,000 cfm at 620° F., with 4.25" sp.

Serving home and industry: **AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS &**

Indianapolis Power & Light Company expands with Indiana

Business, employment and population are constantly growing in the 528-square mile area in central Indiana served by the Indianapolis Power & Light Company. To keep pace, IP&LC will have invested $132,000,000 for modernization and expansion in the 12-year period from 1946 through 1957. Now, the five generating plants provide a generating capability of 530,000 kw, which will be increased to 635,000 kw by the installation of a sixth White River unit by the end of 1955.

A progressive, investor-owned utility, IP&LC strives to give better service . . . to keep capacity higher than the increasing demand for abundant, low-cost electricity.

Every year since 1946, IP&LC has expanded its facilities . . . and, at the same time, reduced the average price of a kilowatt hour! IP&LC credits this record partly to new methods of operation and efficient equipment — including American Blower Forced and Induced Draft Fans, Vaneaxial Fans and Dust Collectors.

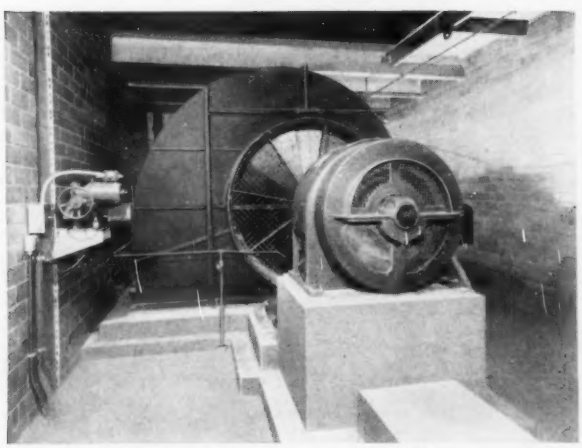
Power plant operators everywhere are specifying American Blower Mechanical Draft Fans, Dust Collecting Equipment, Fly Ash Precipitators and Gyrol Fluid Drive for boiler feed pump and fan control. They know they can depend on American Blower Equipment and technical assistance.

If you have an air handling problem, or plan to expand or modernize, contact your nearest American Blower Branch Office, or write us direct.

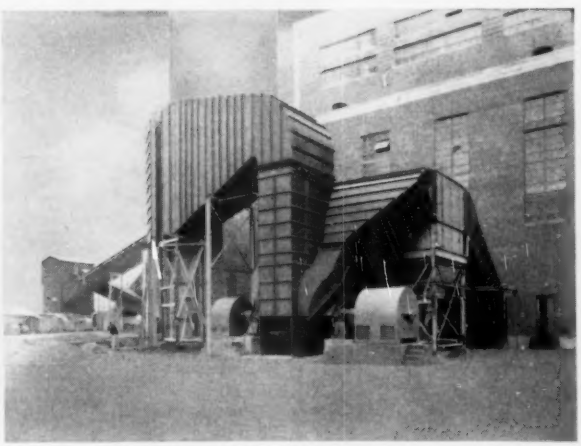
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER



American Blower Forced Draft Fan at the White River Plant. It is rated at design point for 190,000 cfm at 105° F., with 11.7" sp. Driving motor for fan develops 500 hp at 855 rpm.



Outdoor installation at White River Plant of an American Blower Induced Draft Fan. Rated at design point for 335,000 cfm at 380° F., with 14" sp. Driven by 1250 hp, 585 rpm motor.

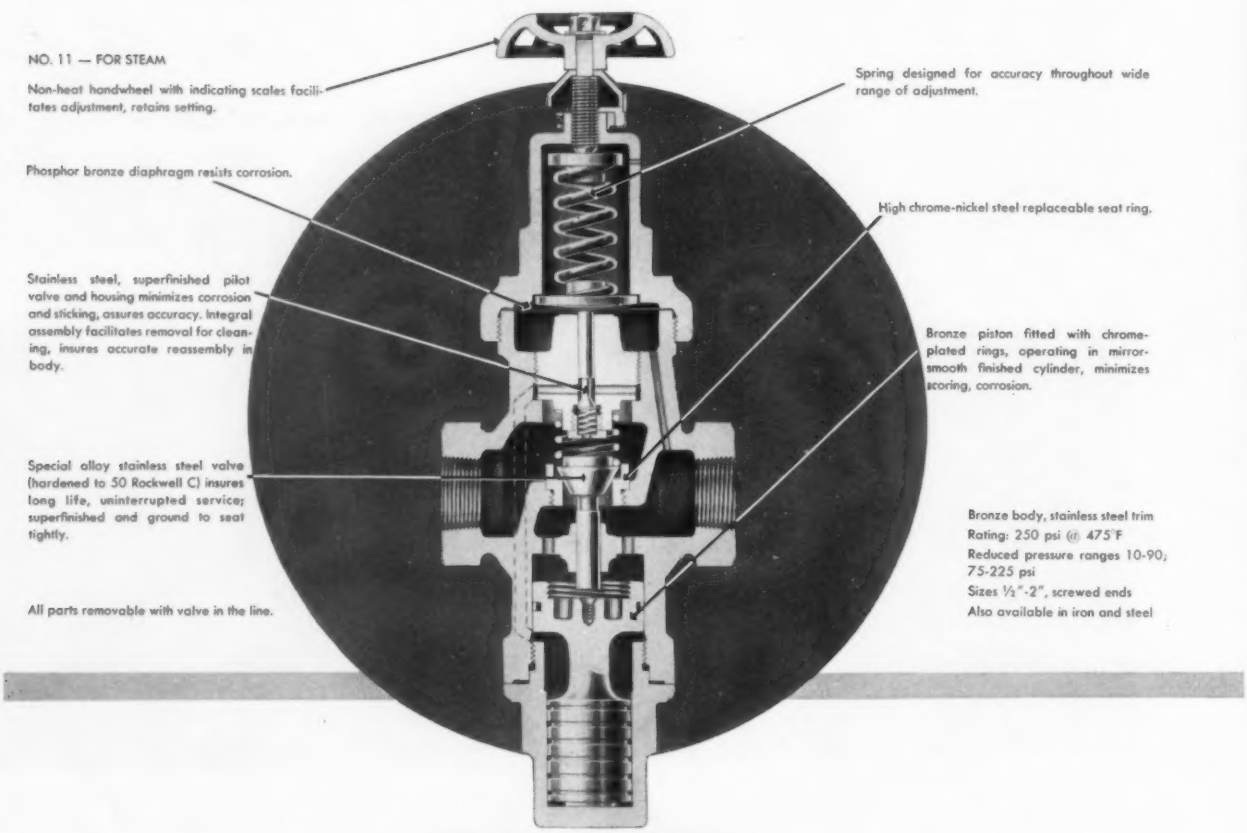
WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

MASONEILAN

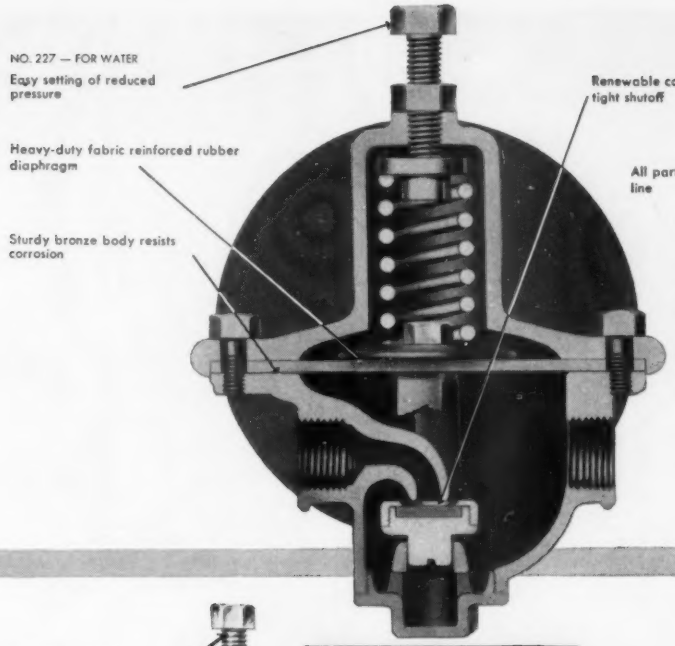
Some Quick Tips from Mason-Neilan on

SELECTING A PRESSURE REGULATOR

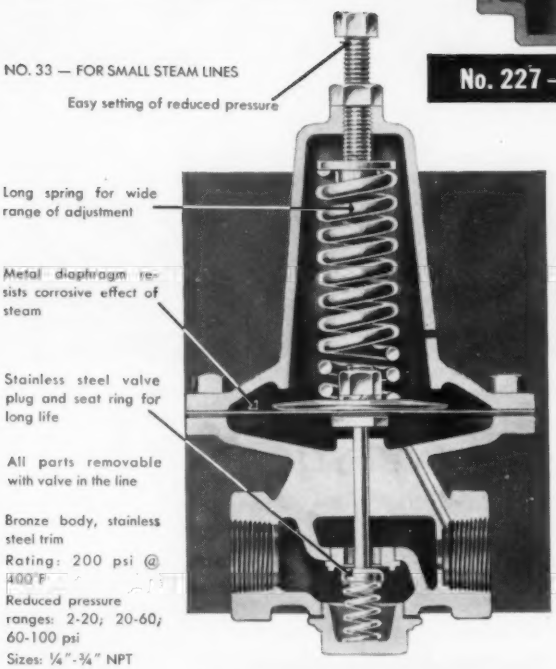
The best regulating valve for any specific application is the one that meets your accuracy requirements, fits the operating conditions, and gives you the lowest combination of maintenance and initial costs. Mason-Neilan engineers or your Mason-Neilan Distributor will be glad to discuss your problem, and help you to make this analysis. But here are some important features you should know and look for that will help you to make your own selection.


NO. 11 — FOR STEAM
Non-heat handwheel with indicating scales facilitates adjustment, retains setting.
Phosphor bronze diaphragm resists corrosion.
Stainless steel, superfinished pilot valve and housing minimizes corrosion and sticking, assures accuracy. Integral assembly facilitates removal for cleaning, insures accurate reassembly in body.
Special alloy stainless steel valve (hardened to 50 Rockwell C) insures long life, uninterrupted service; superfinished and ground to seat tightly.
All parts removable with valve in the line.
Spring designed for accuracy throughout wide range of adjustment.
High chrome-nickel steel replaceable seat ring.
Bronze piston fitted with chrome-plated rings, operating in mirror-smooth finished cylinder, minimizes scoring, corrosion.
Bronze body, stainless steel trim
Rating: 250 psi @ 475°F
Reduced pressure ranges 10-90; 75-225 psi
Sizes ½"-2", screwed ends
Also available in iron and steel

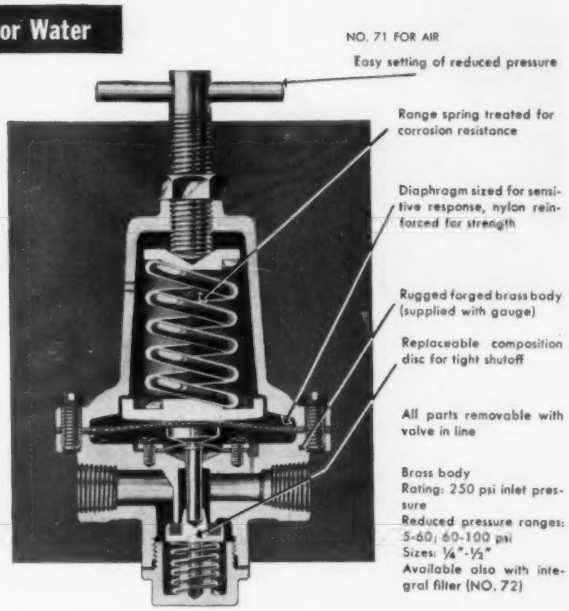
No. 11 – For Steam


NO. 227 — FOR WATER
Easy setting of reduced pressure
Heavy-duty fabric reinforced rubber diaphragm
Sturdy bronze body resists corrosion
Renewable composition disc valve insures tight shutoff
All parts removable with valve in the line
Bronze body, screwed ends
Rating: 150 psi @ 100°F
Reduced pressure ranges: between 10 and 60 psi
Sizes: ¼"-2"

No. 227 – For Water


NO. 33 — FOR SMALL STEAM LINES
Easy setting of reduced pressure
Long spring for wide range of adjustment
Metal diaphragm resists corrosive effect of steam
Stainless steel valve plug and seat ring for long life
All parts removable with valve in the line
Bronze body, stainless steel trim
Rating: 200 psi @ 400°F
Reduced pressure ranges: 2-20; 20-60; 60-100 psi
Sizes: ¼"-¾" NPT

No. 33 – For Small Steam Lines


NO. 71 FOR AIR
Easy setting of reduced pressure
Range spring treated for corrosion resistance
Diaphragm sized for sensitive response, nylon reinforced for strength
Rugged forged brass body (supplied with gauge)
Replaceable composition disc for tight shutoff
All parts removable with valve in line
Brass body
Rating: 250 psi inlet pressure
Reduced pressure ranges: 5-60; 60-100 psi
Sizes: ¼"-½"
Available also with integral filter (NO. 72)

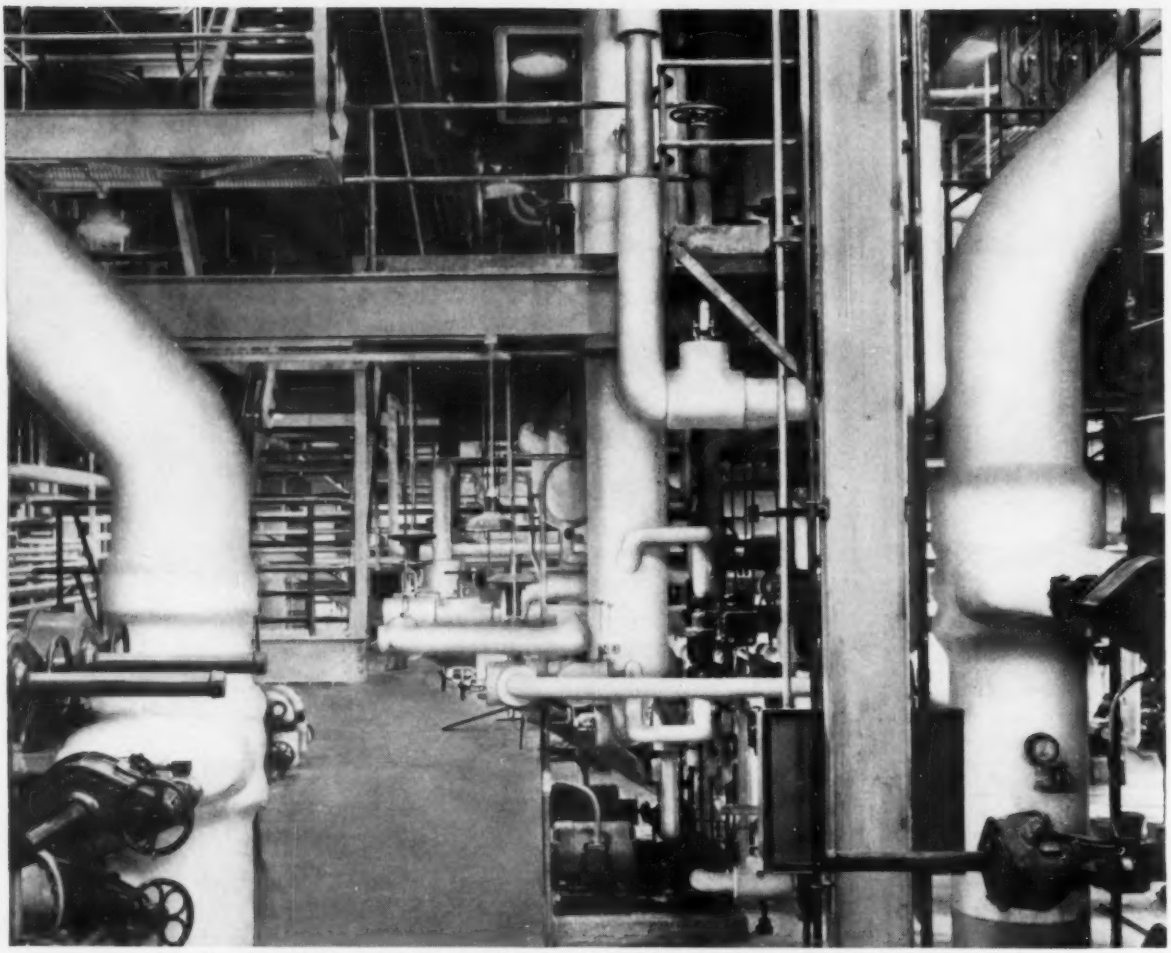
No. 71 – For Air

ALL HIGH Q (Quality Coefficient) PRODUCTS

MASON-NEILAN REGULATOR CO.

1186 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa • Philadelphia • Houston Pittsburgh • Atlanta • Cleveland • Cincinnati • Detroit • San Francisco • Boise • Louisville • Salt Lake City • El Paso Albuquerque • Odessa • Charlotte • Los Angeles • Corpus Christi • Denver • Appleton • Birmingham New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



Extraction unit and piping insulated with "Featherweight" 85% Magnesia. Sabrooke Plant, Rockford, Ill., of the Central Illinois Electric and Gas Co. Insulating Contractor: Standard Asbestos Manufacturing Co., Chicago

BEFORE YOU INSULATE, INVESTIGATE

"Featherweight"® 85% MAGNESIA

The Sabrooke Plant of the Central Illinois Electric and Gas Co. (illustrated) is typical of the thousands of installations where "Featherweight" 85% Magnesia efficiently conserves heat.

"Featherweight" 85% Magnesia has for years—more than 60—effectively fulfilled the needs of schools, hospitals, hotels, apartment and office buildings, power plants, factories—wherever efficient conservation of heat is of importance.

"Featherweight" 85% Magnesia is more than efficient. It cannot burn and will not corrode because it is inorganic. It is light in weight and structurally stable. It is made in simplified thicknesses for pipe installations, so that each size and thickness will fit over or into another size and thickness. This is important where two layer thicknesses are desired and for reducing inventories.

If your company has an insulating problem, the chances are that "Featherweight" 85% Magnesia can help you save heat, save money! Your K&M distributor is an experienced applicator who will gladly give you more information, or write directly to us.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

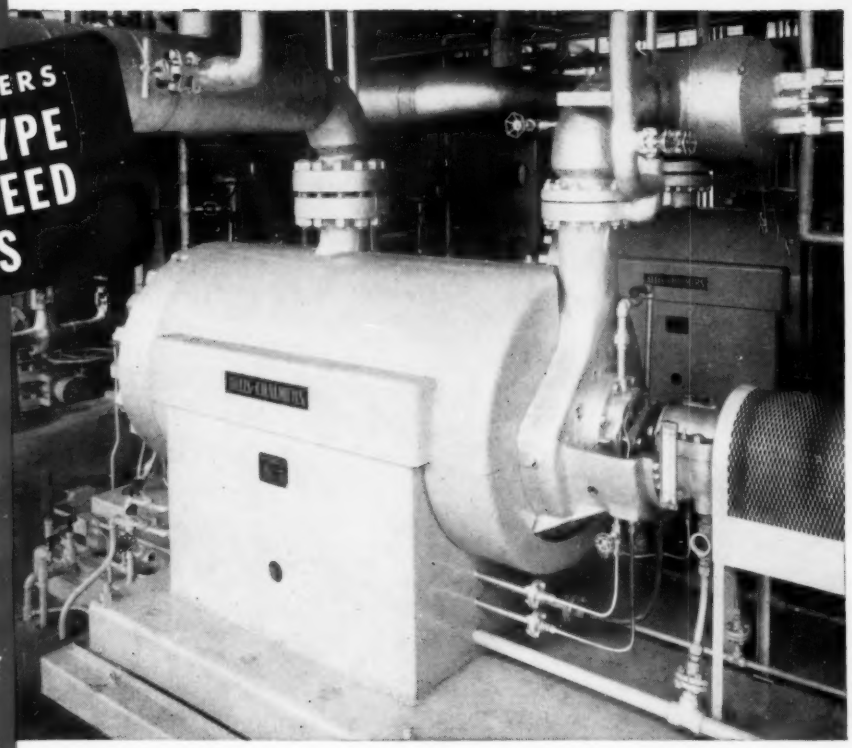
Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

In Canada: Atlas Asbestos Co., Ltd. • Montreal, Toronto, Winnipeg, Vancouver

K&M best in asbestos ®

ALLIS-CHALMERS

BARREL-TYPE BOILER FEED PUMPS



Preferred by
LOUISIANA POWER & LIGHT COMPANY
because

PERFORMANCE IS PROVED *in service*

PERFORMANCE RECORDS in power plants all over the country show *low maintenance, high efficiency*... that's one reason Allis-Chalmers boiler feed pumps were chosen for the Nine Mile Point Station of Louisiana Power & Light Company.

PROVED DESIGN FEATURES

Behind the A-C boiler feed pump stand many proved design features. For example: First stage has twin, single suction impellers to give low NPSH requirements for highest efficiency under fluctuating loads. Impellers mounted back to back balance axial forces without the need for a balancing drum. Expansion joint and seals are brought to the outside of the pump . . . they may be inspected often and worked on easily, if required.

COMPLETE UNIT FROM THE SOURCE

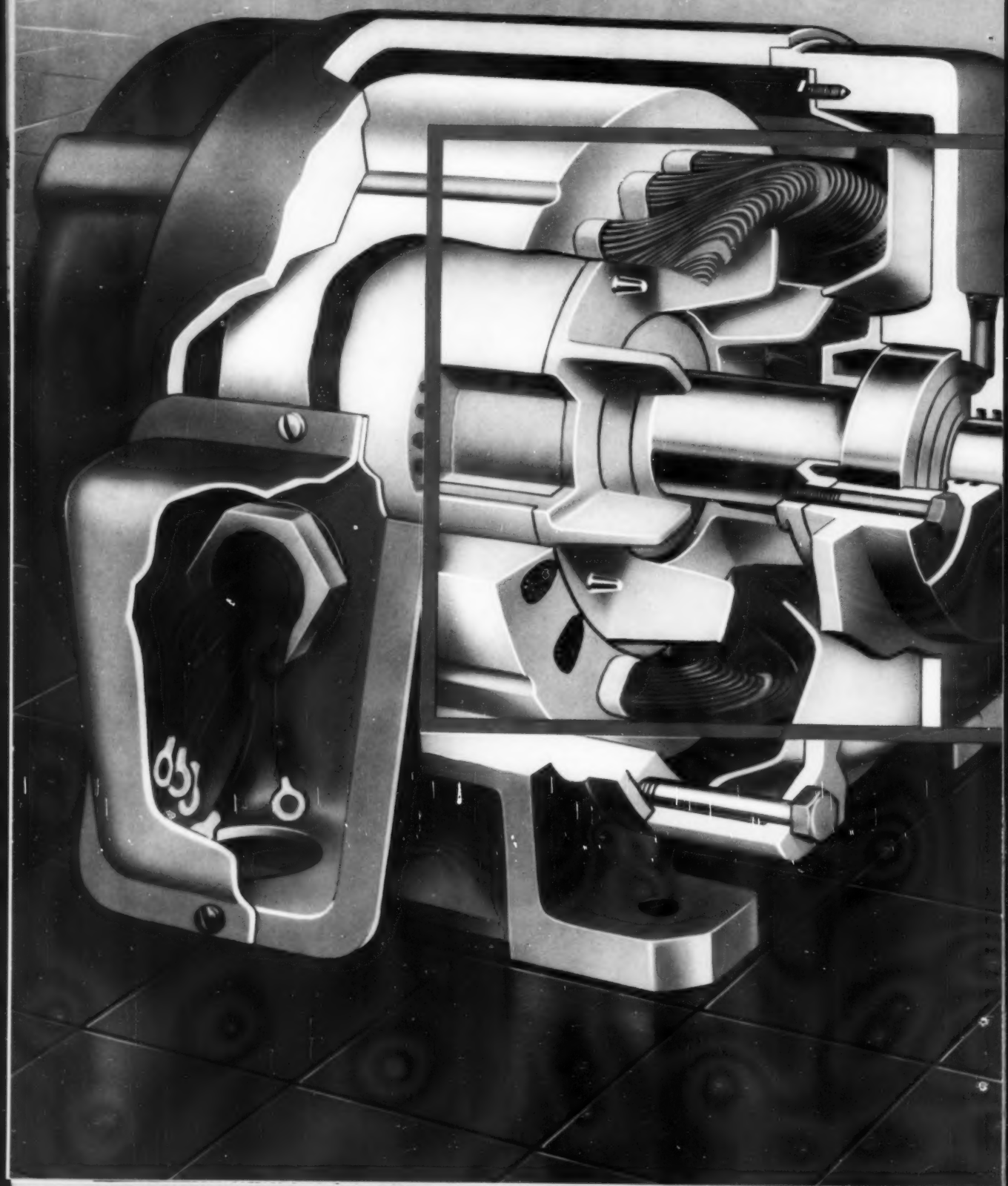
Allis-Chalmers can supply the complete pumping unit — pump, motor and control — all of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis., and ask for Bulletin 08B7899.

A-4328

ALLIS-CHALMERS

Get Greater
with New Features

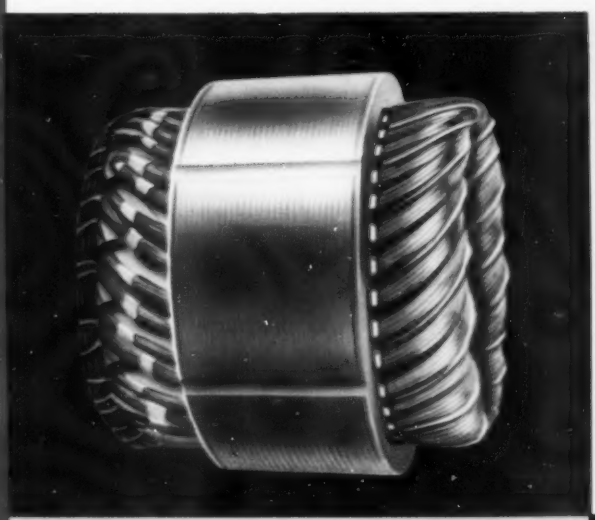


Motor Economy
. . . Proved Principles

Here's the inside story of a great new motor. It combines the best of the new developments in methods and materials with the best of the tried and proved principles that have made such an outstanding record for Allis-Chalmers motors.

Smaller in size than previous designs, it offers greater protection against damage from falling liquids and solids. The bearing design gives greater bearing protection, ease of maintenance and long life. Insulation gives you famous Allis-Chalmers rugged dependability.

Consult your nearby Allis-Chalmers Authorized Distributor or District Office on your motor needs. Or write for Bulletin 51B6210.



STATOR DOUBLE INSULATED—Stator laminations are welded across back for rigidity. Heavy varnished cambric insulation is inserted between phase windings. Wound stator is dipped several times in special insulating varnish of proved effectiveness and stamina, and baked after each dip. The Allis-Chalmers stator is both physically and electrically strong . . . thoroughly protected against moisture, heat and corrosion.

RIGID CAST-IRON FRAME—Heavy, distortion-free cast-iron frame holds bearings in rigid alignment . . . gives all-around protection against physical damage . . . resists rusting.

Air intakes are well protected by being located on the underside of the end housing. There is plenty of room for free air circulation on the back of the stator core for efficient, even cooling. Air is discharged horizontally and to the sides.

Multiple bearing protection keeps grease in... keeps dirt out...permits relubrication in service

Extreme care has been taken to provide longest possible bearing life and lowest possible maintenance costs. The bearing itself is of double-shielded type, which allows controlled migration of grease in and out of the bearing to suit operating conditions. Yet bearing is protected against greatest cause of bearing trouble — overgreasing.

Close running clearances and double labyrinth seals between the shaft and outer bearing housings keep grease in the bearing and exclude dirt. Grease is kept out of the interior of the motor by a bearing cap with a long running clearance along the shaft. The cap is held tightly in place by hex head cap screws. Large grease chambers hold an ample supply of lubricant.

A-4362

ALLIS-CHALMERS

MILWAUKEE 1, WISCONSIN

When power demands GROW

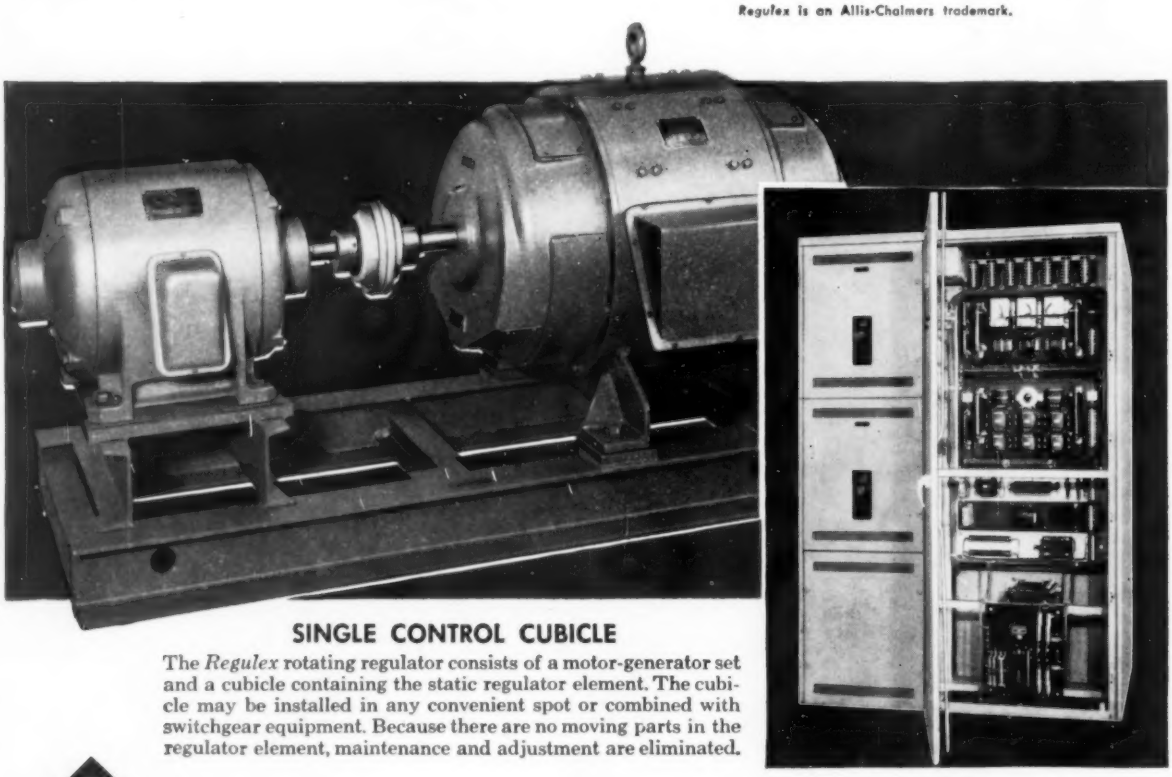
. . . gain additional Kilowatts with . . .

Regulex VOLTAGE REGULATORS

GENERATORS straining under the demand for ever-increasing kilowatt output take a new lease on life with the addition of *Regulex* voltage regulators. Automatic minimum excitation afforded by the *Regulex* voltage regulator allows the generator to operate close to the pull-out limit. Exceptional sensitivity and rapid response establish and maintain a safe ratio between generator load and field current. Operating limits at any given power factor are increased . . . best reactive kva division assured. It all adds up to maximum safe kilowatt output . . . more power to sell from your present generating equipment. For complete information call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4369

Regulex is an Allis-Chalmers trademark.



SINGLE CONTROL CUBICLE

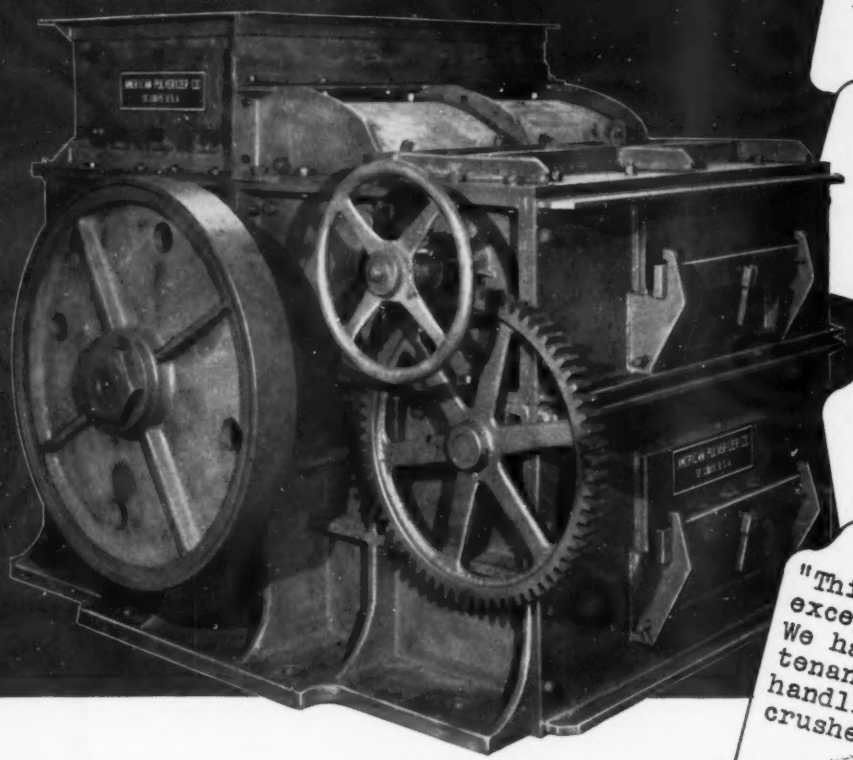
The *Regulex* rotating regulator consists of a motor-generator set and a cubicle containing the static regulator element. The cubicle may be installed in any convenient spot or combined with switchgear equipment. Because there are no moving parts in the regulator element, maintenance and adjustment are eliminated.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

users tell us...

AMERICAN COAL CRUSHERS GIVE GREAT PERFORMANCE AT LOW COST



"This machine has crushed 175,000 tons of coal without replacement parts"

"Has given the least trouble of any machine in our power plant"

"Very dependable piece of equipment"

"A reliable and well applied unit, consistently producing a uniform product"

"This crusher has been giving exceptionally good service. We have had very little maintenance. Does a better job handling wet coal than most crushers"

"We have never done any maintenance work on the crusher. It is still in very good condition with little or no evidence of wear. The repair parts we ordered are being kept in stock for future use"

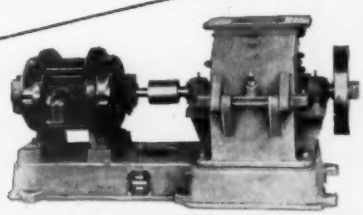
Performances in hundreds of mines, power plants and central stations have proved conclusively that American Coal Crushers can crush coal for *less than 1¢ per ton,* including depreciation, replacement parts, power and interest on original investment.

Write us today indicating your special needs in coal crushing equipment. We'll be glad to give recommendations and cost estimates.

When You Figure Cost Per Ton, the Best Answers Come From American

COAL CRUSHERS
Up to 800 TPH

SAMPLE CRUSHERS
To Suit Your Requirements



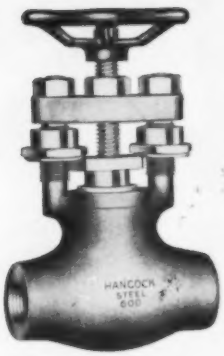
FOR LOW-COST COAL-SAMPLE CRUSHING
Model 15 x 9 American Sample Crusher for capacities up to 2000 lbs. per hr.

American PULVERIZER COMPANY

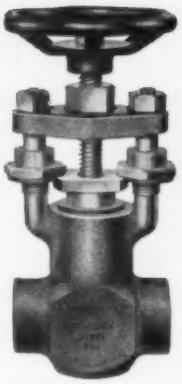
Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

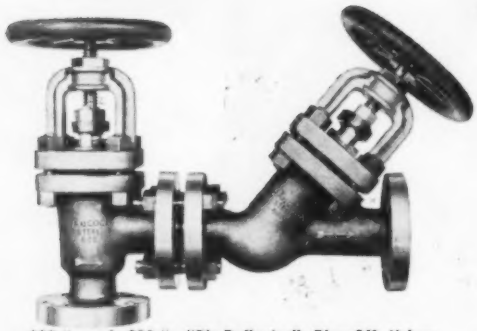
for the economy of quality...



600# Steel Valves. Dependable trouble-free in the severest services. **No Bonnet Joint Design. Sizes:** ¼" through 2". **Types:** Globe and Angle. **Connections:** Screwed, Socket Weld and Flanged Ends. **Service Ratings:** For all pressures up to 850 psi at 775° F. — O.W.G. 2000#, 100° F.

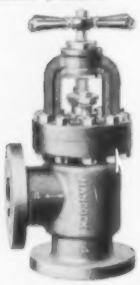


800# Steel Gate Valves. Do a job and stay on the job. **Sizes: No Bonnet Joint Design**—¼" through 2", **Bolted Bonnet Design**—¼" through 2". **Connections:** Screwed, Socket Weld and Flanged Ends. **Service Ratings:** For all pressures up to 800 psi at 775° F. — O.W.G. 2000#, 100° F.

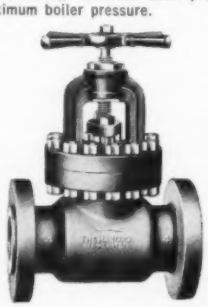


300# and 600# "Bio-Deflector" Blow-Off Valves. Surpass all land and marine codes and insurance provisions. **Sizes:** 1½", 2" and 2½". **Types:** Straightway and Angle. **Connections:** 300# — Flanged or Screwed Ends; 600# — Flanged or Socket Weld Ends. **Pressures:** 300 psi, 800° F.—515# maximum boiler pressure; 600 psi—950# maximum boiler pressure.

1500# and 2500# Steel Blow-Off Valves. Superior in performance regardless of the demands of the installation. Weight and space savers. **No Bonnet Joint Design. Sizes:** 1", 1½", 2" and 2½". **Types:** Straightway and Angle. **Connections:** Socket Weld Ends standard. Flanged if required. **Pressures:** 1500 psi, 1050° F.—2080# maximum boiler pressure; 2500 psi—3120# maximum boiler pressure.



300# and 600# Cast Steel Valves. Installed in practically all power plants. **Sizes:** 2½" through 6". **Types:** Globe, Angle and Check. **Connections:** Flanged or Screwed Ends. **Service Ratings:** 300 psi, 800° F.—O.W.G. 600#, 100° F; 600 psi—O.W.G. 1200#, 100° F.



HANCOCK VALVES

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Take advantage of his knowledge and experience in selecting the right Hancock Valve for each service requirement. You can depend on him for prompt deliveries from local stocks.

specify HANCOCK VALVES

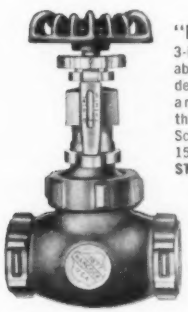
To get the most value from your valve investment, you must have the assurance of efficient, trouble-free performance.

Hancock Valves give you *economy of quality* that makes them your best buy in terms of long, reliable service. They have advanced construction and operational advantages found in no other valves—features backed by more than 75 years of pioneering new designs, new materials and new manufacturing techniques in anticipation of changing needs.

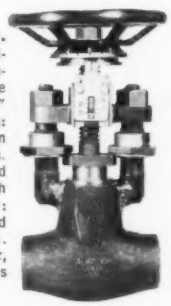
Rugged, precision-built Hancock Valves are noted for dependable tightness month after month under the most adverse conditions of use. They do a job and stay on the job—withstand the deteriorating effects of wire drawing, galling, steam cutting, erosion and corrosion far longer because they are functionally designed and made from carefully selected materials of the highest quality. Standardization of parts in all sizes of each type of valve provides the interchangeability factor so essential to simplified inventory and low-cost maintenance.

The operational perfection and extra service life engineered into all Hancock Valves are yours at the cost of ordinary valves. Whether you are adding new capacity to present facilities, planning a new plant or a revalve project, learn all the money-saving reasons why Hancock Valves belong in your specifications. Complete information is yours on request.

1500# and 2500# Steel Valves. The safest, most dependable shut-off valves obtainable. **No Bonnet Joint Design. Sizes:** ¼" through 2". **Types:** Globe and Angle. **Connections:** Socket Weld Ends standard. Flanged if required. **Service Ratings:** Up to 2500 psi, 1050° F. — O.W.G. 6000#, 100° F.



"Flocontrol" Valves. 3-in-1 design combines variable orifice, shut-off and index. **BRONZE: Types:** Globe and Angle. **Sizes:** ¼" through 2". **Connections:** Screwed Ends. Available in 150# and 300# series. **STEEL: Types:** Globe and Angle. **Sizes:** ¼" through 4". **Connections:** Screwed, Socket Weld and Flanged Ends. Available with 150#, 300# and 600# series flanges.



600# through 2500# Hi-Pressure Drop Valves. For continuous blowdown service. Combine orifice, shut-off and index in a single unit. **No Bonnet Joint Design. Sizes:** ¾", 1" and 1½". **Orifice Sizes:** ⅛" minimum, 1" maximum. **Connections:** Screwed or Socket Weld Ends.

When Hancocks go in, valve costs go down.

1877 HANCOCK U.S.A.

A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

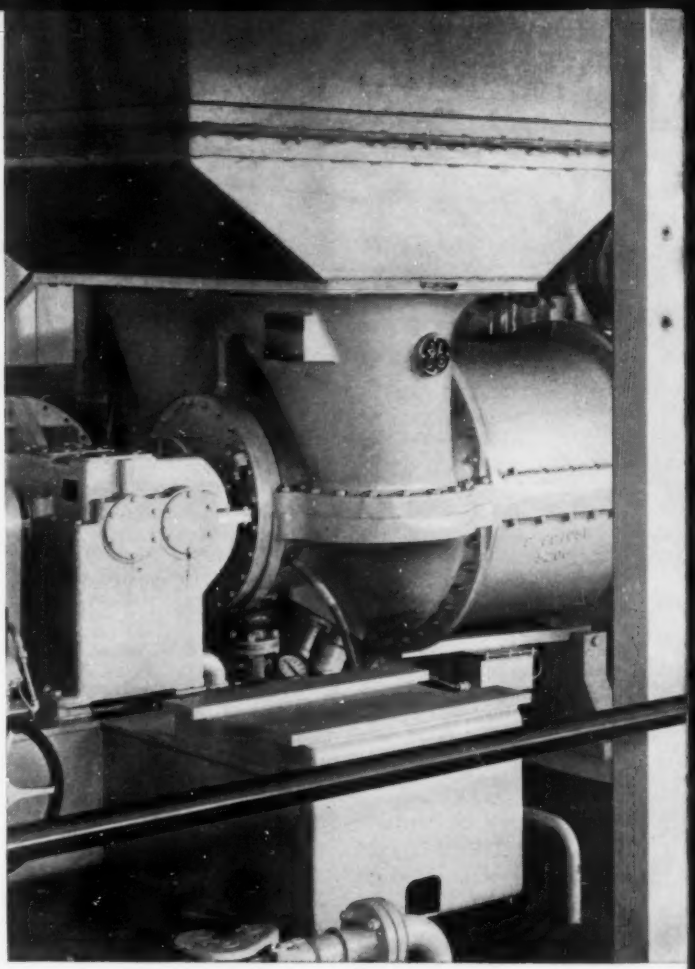
WATERTOWN 72, MASSACHUSETTS

MAXWELL MANNING M&M MOORE INC. TRADE MARK

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

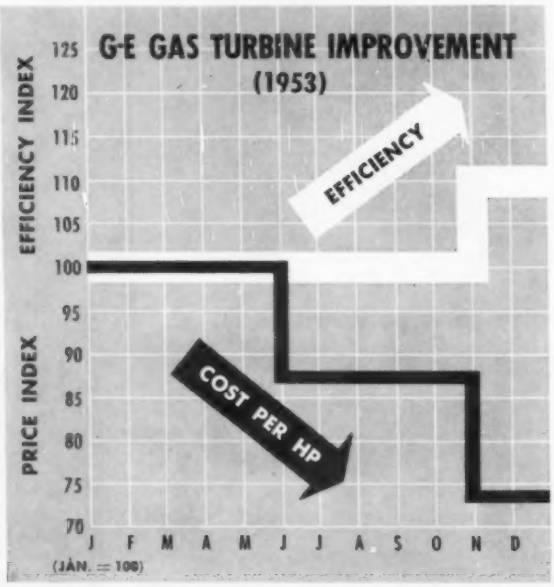
GAS TURBINE

progress report



In the past year, G-E engineers have reduced the cost per hp of the G-E gas turbine—and boosted its efficiency an average of 11 per cent. You may be able to put this versatile prime mover to work providing low-cost power for your plant.

Increased Efficiency, Versatility,



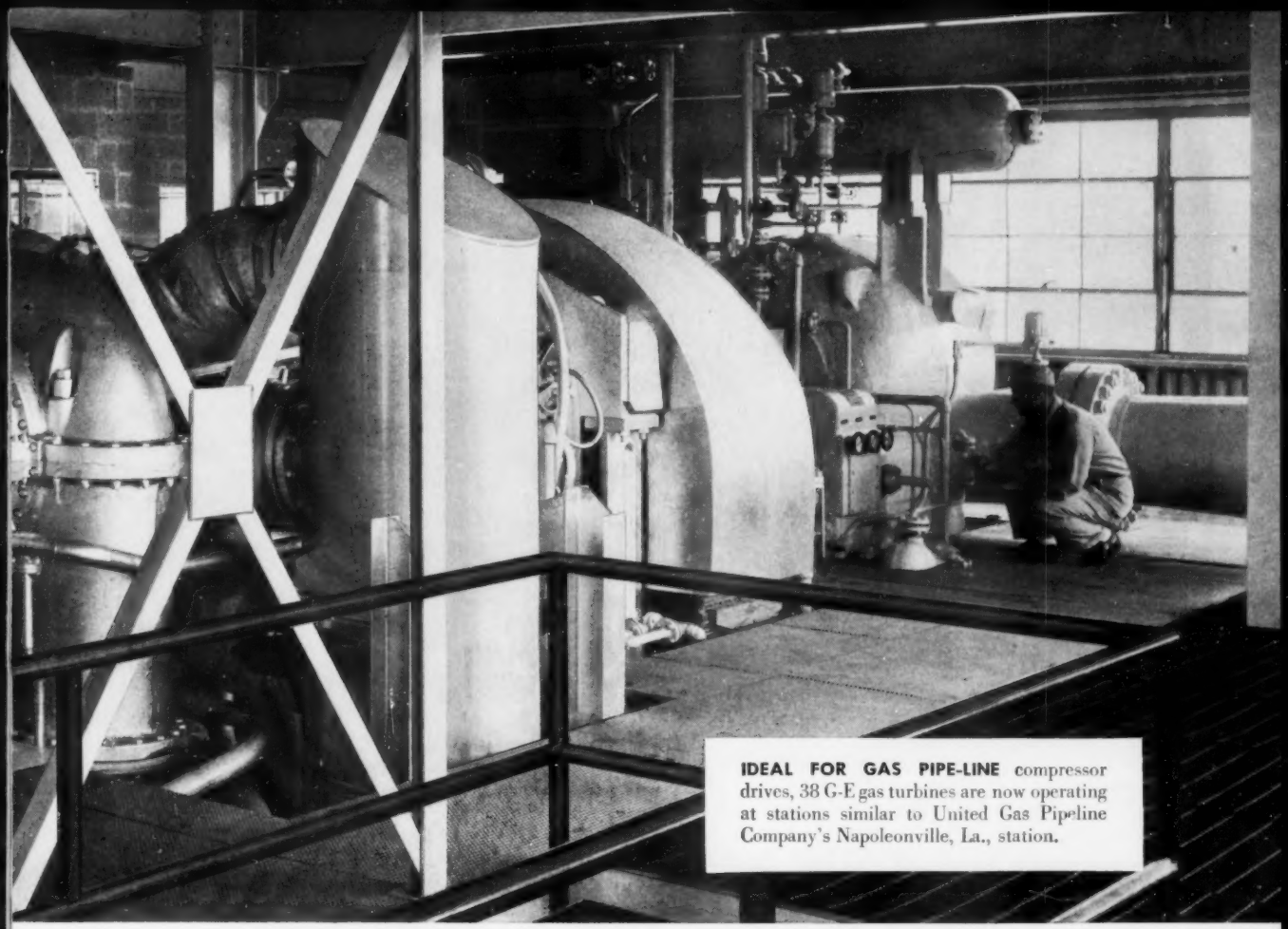
GREATER EFFICIENCY AND LOWER COST PER HP, achieved by improved design and manufacturing techniques, were significant G-E gas-turbine advances in 1953.

G-E GAS TURBINE OPERATING RECORD

(As of March 15, 1954)

TYPE OF SERVICE	NO. OF UNITS	OPERATING HOURS
LOCOMOTIVES	11	60,000
POWER GENERATION	16	70,000
GAS PIPE-LINE PUMPING	38	150,000
PETRO-CHEMICAL	1	3,000
TOTAL	66	283,000

UNEQUALED RECORD for operating hours and diversity of application, shows versatility and dependability of G-E gas turbine, gives G-E engineers vital data for future progress.



IDEAL FOR GAS PIPE-LINE compressor drives, 38 G-E gas turbines are now operating at stations similar to United Gas Pipeline Company's Napoleonville, La., station.

Lower Cost Per Horsepower Mark G-E Gas-turbine Progress

In less than five years, what was a completely new, un-tried prime mover has been shaped into a dependable, economical means of power. Already G-E gas turbines have racked up over 280,000 hours driving railroad locomotives, generating electric power, and turning high-speed compressors for gas pipe-line pumping and other industrial processes.

In the past year alone, G-E engineers have reduced the cost per horsepower for the gas turbines an average of 26 per cent. In the same short span, they have boosted efficiency an average of 11 per cent.

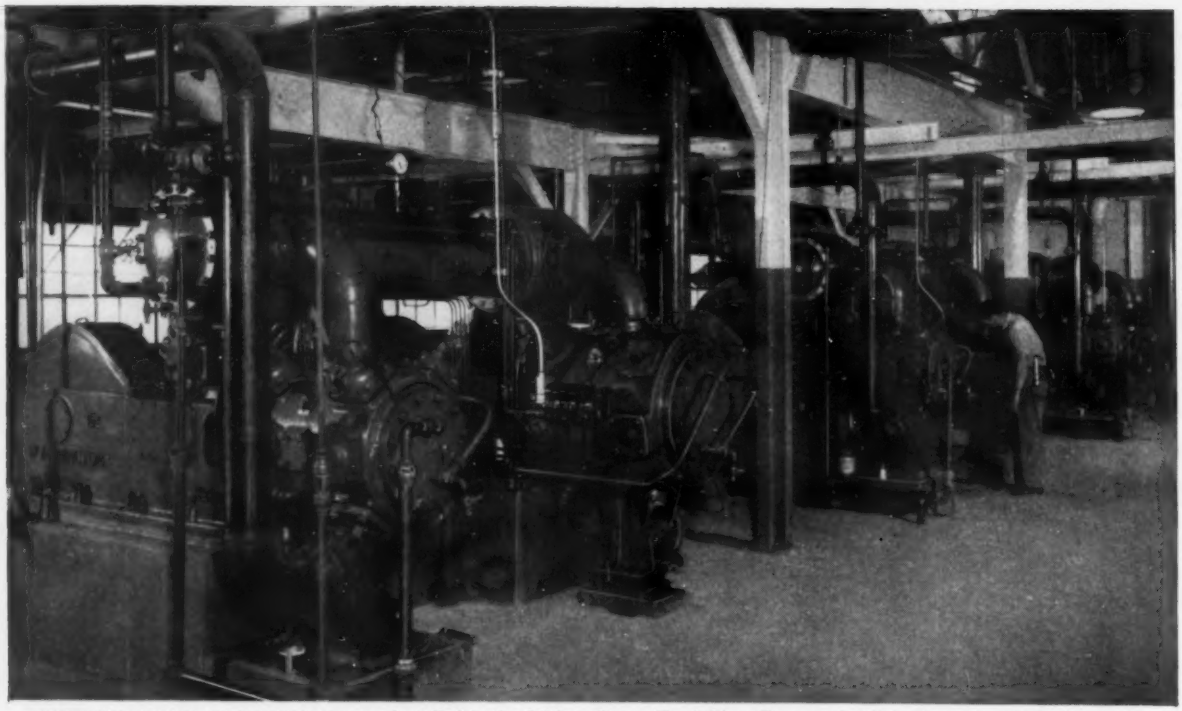
Outstanding among recent improvements is an integral base on which the turbine and its auxiliary equipment are permanently mounted and shipped—substantially reducing installation costs.

How could all this happen? General Electric, leader in the design and manufacture of both steam turbines and jet engines, was well equipped to develop the combustion gas turbine. Now, with thousands of hours of operating experience already accumulated, and with a factory designed exclusively for their manufacture, G.E. is leading the way in the gas turbine field.

If you would like more information on the gas turbine, contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Section 255-10, Schenectady 5, New York.

Progress is our most important product

GENERAL ELECTRIC



WORTHINGTON DC-2 COMPRESSORS are installed in the Libbey-Owens-Ford Glass Company's Fiber-Glass plant in Parkersburg, West Virginia. They have five-step variable capacity controls enabling them to operate with a minimum power consumption.

Compressed air helps turn a single glass marble into 42 miles of textile filament!

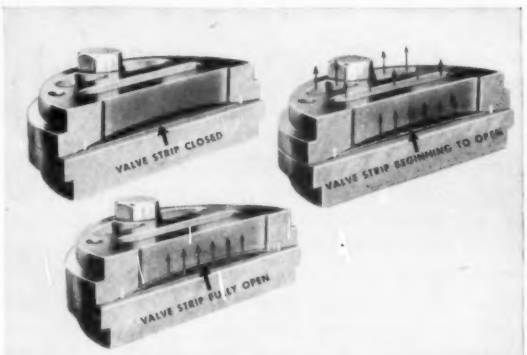
Libbey-Owens-Ford uses Worthington compressors in the manufacture of fiber glass

Daily, more than 40 million miles of filament, gathered into strands of fiber glass, twisted into yarns, and woven into industrial cloth, tape and other textile forms, are produced at the Libbey-Owens-Ford plant at Parkersburg, West Virginia.

The fiber glass filament is made by melting specially prepared glass marbles in small furnaces and drawing the glass through the minute apertures of a "bushing". Humidity is important in handling these continuous fibers of glass and compressed air is used to maintain accurate man-made weather. Compressed air is actually used in 22 important operations in making fiber glass in this ultra-modern factory.

Three Worthington DC-2 compressors, each with five-step capacity control, supply the air pressure required in these many delicate tasks.

Whatever your requirements for compressed air, Worthington builds compressors to meet them. Write us about your compressor problems. Worthington Corporation, Compressor Division, Section K.4.1, Buffalo, N.Y.



WORTHINGTON'S EXCLUSIVE FEATHER* VALVE lowers compressor fuel consumption. A series of thin flexible strips of ribbon steel lift and flex uniformly as shown. This lightest, tightest, most durable valve ever made is standard on all Worthington compressors. *Reg.U.S.Pat.Off.

K.4.1

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors

His testing makes CHASE® Antimonial Admiralty Condenser Tubes the *best you can buy!*

TOUGH is the word for the Chase Expansion Test pictured above. A pin with a 1½″ per ft. taper is driven into the end of a Chase Condenser Tube which must withstand an increase of *20% in diameter.*

This test is just one of many that Chase Tubes must pass.

Chase *ANTIMONIAL ADMIRALTY* Tubes must pass far sterner tests in the Chase Laboratories than they will ever encounter under normal tube usage. That's why they last for years in actual use. It pays to insist on Chase.

CHASE WAREHOUSE STOCKS: Los Angeles, New Orleans
Prompt Delivery from Cleveland and Waterbury Mills

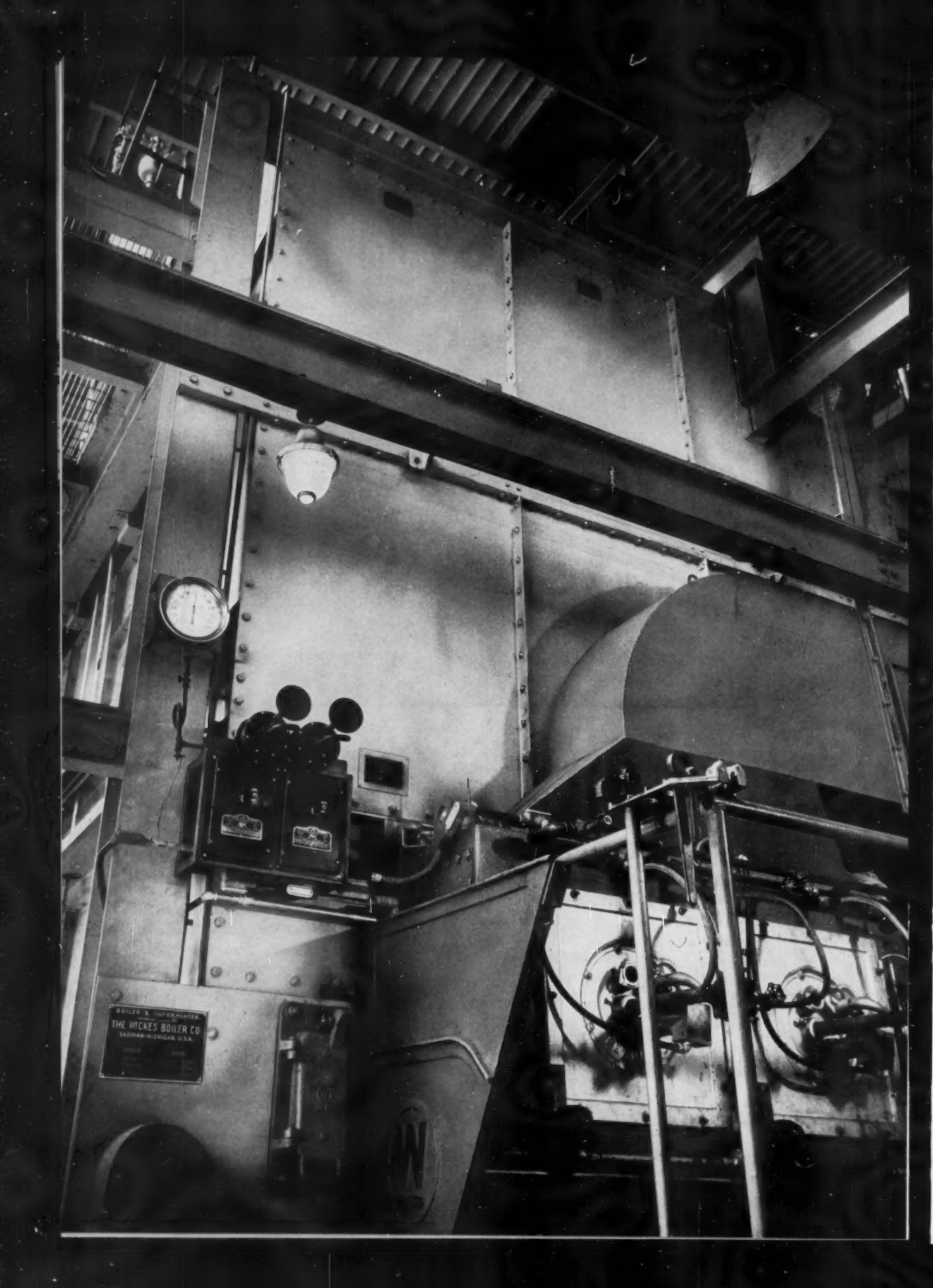
Chase®

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)


BUILT & SUPERHEATED BY
THE WICKES BOILER CO
SAGINAW MICHIGAN U.S.A.

WICKES

3-drum boiler at KEELER BRASS COMPANY

Installation of a new 3-drum WICKES Water Tube Steam Generator has substantially increased operating efficiency at the Keeler Brass Company, Grand Rapids, Michigan, the world's largest manufacturer of furniture hardware. The new boiler, a combination oil-fired and underfeeder stoker unit, is capable of producing 40,000 lbs. of steam per hour at 350 psi.

WICKES will design and build water tube steam generators for any practical size and pressure. WICKES also offers a wide choice of auxiliary equipment so that it's possible for you to get not only the best steam generator, but also the best correlated equipment. Contact your nearest WICKES sales representative or write us today.

OUR 100th YEAR

THE WICKES BOILER CO.

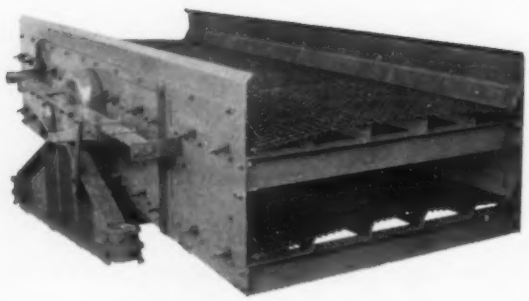
DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 **• SALES OFFICES:** Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.

HEWITT HR ROBINS can cut your handling costs

with this complete

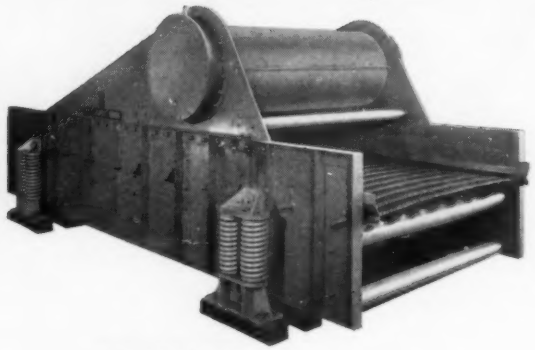
FOR SCREENING



GYREX°

Positive Stroke 4-Bearing Screens

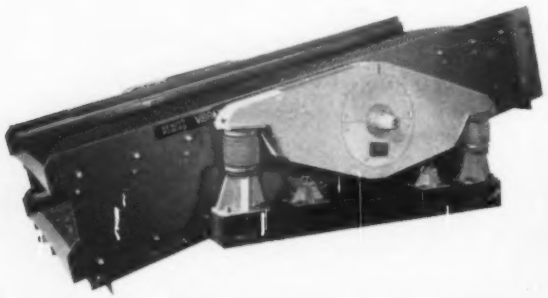
STROKES: ¼" at 1,000 r.p.m. and ½" at 625 r.p.m.
SIZES: Complete range of standard sizes from 48" x 78" to 72" x 192".
DECKS: Single—Double—Triple.
MOUNTINGS: Anvil-type cast iron base with *exclusive angle adjustment* for floor mounting—Steel I-beam base for suspended or rigid mounting.



ELIPTEX°

Horizontal Operating Flat Screens

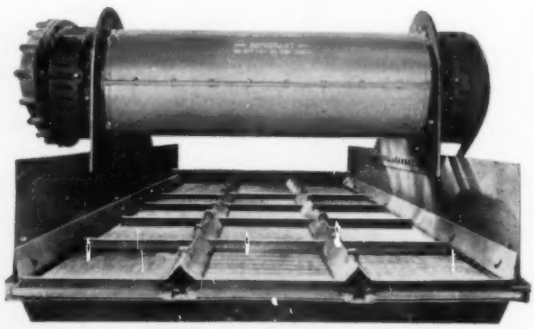
STROKES: 7/16" nominal at 1,000 r.p.m.—Other stroke and speed combinations available to meet special applications.
SIZES: All standard sizes from 36" x 96" to 72" x 240".
DECKS: Single—Double—Triple.
MOUNTINGS: Floor mounted or Suspended arrangement.



VIBREX°

Full-Floating, Unbalanced Pulley-Type 2-Bearing Screens

STROKES: Available in many stroke and speed combinations ranging from ⅛" at 1,800 r.p.m. to ½" at 660 r.p.m. —All Vibrex screens have readily adjustable stroke to meet the most exacting operating conditions.
SIZES: All standard sizes from 16" x 30" to 72" x 192".
DECKS: Single—Double—Triple.
MOUNTINGS: *Exclusive angle adjustment* for floor mounting —Cable arrangement for suspended mounting.



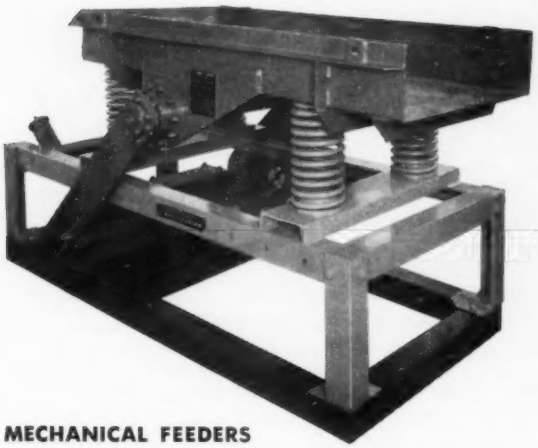
ELIPTEX DEWATERIZER

Specially Designed Eliptex Screen With Micron-Size Opening Stainless Steel Flat Rod Deck

STROKE: Extra-full stroke operating at high speed for maximum efficiency to handle even the most difficult dewatering problems.
SIZES: All standard sizes from 36" x 144" to 72" x 192".
DECKS: Single—Double.
MOUNTINGS: Same as Eliptex Screens.

line of Vibrating Equipment

FOR FEEDING & CONVEYING



MECHANICAL FEEDERS

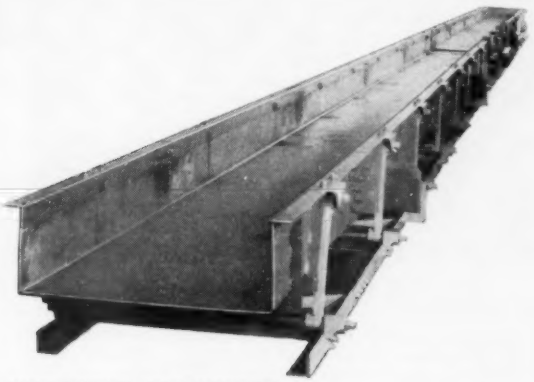
A *fully mechanical* vibrating feeder that is easily maintained by your own personnel. Extremely high capacities at very low power consumption.

FEED CONTROL: Remote, wide range, variable speed controls available.

STROKE: Full 3/16" at 1,000 r.p.m. readily adjustable . . . ideal for handling material of varying characteristics.

SIZES: All standard sizes from 24" x 48" to 48" x 96".

MODELS: Standard—Heavy duty models and special pans and deck designs available . . . suspended or base mountings.



VIBRATING CONVEYORS

A continuously balanced vibrating conveyor offering longer units with higher capacities at lower horsepower than ever before available. Ideal for handling a wide range of materials be it wet or dry, lump or pulverized, packaged or loose, hot or cold, abrasive or corrosive.

SIZES: Standards from 8" to 48" wide up to 150′ long with single drive.

STROKE: Full strokes from 1/4" to 3/8" at speeds of approximately 750 r.p.m.

MODELS: Standard—Heavy duty models and special pan designs and arrangements available.

FOR SHAKING OUT

CAR SHAKEOUTS

Will handle wet, compacted and even partially frozen loads. Capacities vary depending upon characteristics of material . . . Typical unloading time under 5 minutes per car.

MODELS: 5-Ton HD (Heavy-Duty) for handling up to 100 cars per day—3½-Ton GS (General Service) generally recommended for up to 10 cars per day. Both models available with companion twin-hook Car Shakeout Hoist.

STROKE: 5/32" at 1,500 vibrations per minute (easily adjusted for specific applications).

Patent No. 2,504,789

FOUNDRY SHAKEOUTS

Successfully used in steel, iron and non-ferrous foundries of all types (production and jobbing) handling castings weighing from a few ounces up to 60 tons.

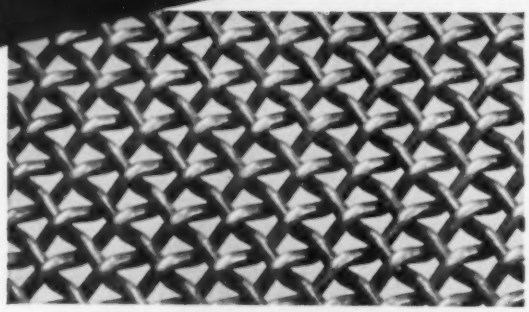
SIZES: From 2′ x 2′ to 8′ x 10′ in single units. Multiple unit arrangements up to 16′ x 33′.

CAPACITIES: Up to 300,000 # (150 tons) in multiple units.

STYLES: Standard Stationary, Portable, Gravity Self-Discharging and Mechanical (Horizontal) Self-Discharging.

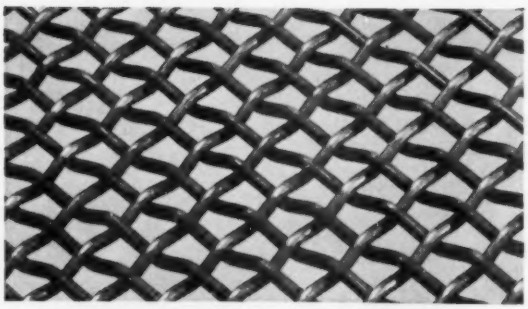
AND FOR YOUR SCREEN CLOTH NEEDS

HEWITT HR ROBINS
can cut your handling costs
with a complete



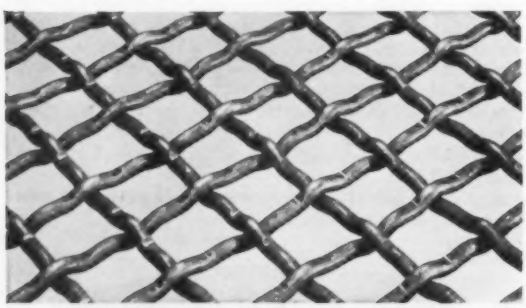
SQUARE OPENING DOUBLE CRIMP

All wires are specially crimped so that a spring tension permanently locks them together at each intersection. This guarantees tightness of weave and accurate sizing because openings cannot vary.



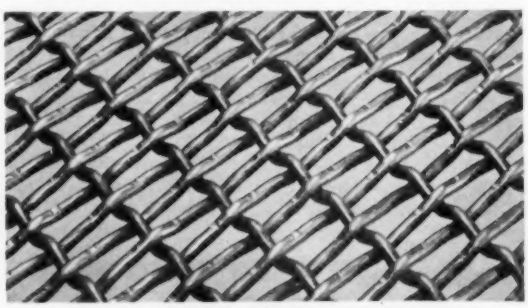
RECTANGULAR OPENING

Recommended for high speed sizing where accuracy is secondary. Rectangular weave provides greater open area hence higher capacity. Furnished with double crimp or flat top weave.



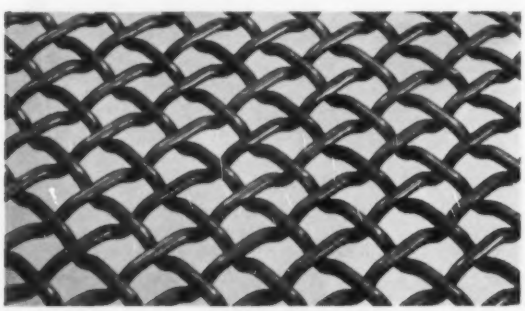
SQUARE OPENING LOCK CRIMP

Ideal for scalping. Has additional crimp to lock wires together under pressure to prevent wires from shifting as a result of impact and handling of oversize materials.



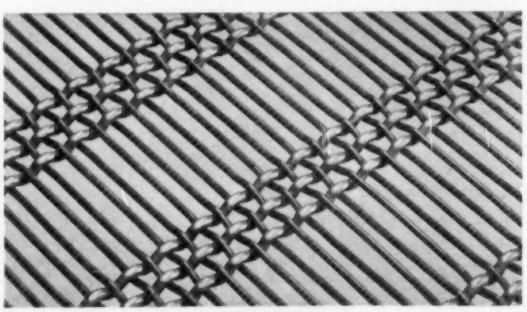
NON-SPREADER

Best for high speed sizing of coarse materials. Heavy-duty wires assist in maintaining accuracy of opening even under impact of wedge-shaped stone and over-sized materials.



FLAT TOP

Crimp characteristics provide smooth screening surface. Absence of high spots, as in other types of crimp, permits free flow and reduces abrasive action of material. Assures longer wear, faster screening and less degradation.



NON-BLIND

Recommended for processing moisture-laden materials that plug or blind openings. Slotted openings kept free from blinding due to secondary vibration set up in longer span wires. Clustered wires carry heavy tension and are crimped to maintain width of opening.

line of Screen Cloth

Each Type of Hewitt-Robins Screen Cloth is Specially Engineered To Accurately Size Large Tonnages . . . Last Longer . . . Cut Your Screening Costs

Hewitt-Robins Screen Cloth guarantees overall sizing accuracy through precision-weaving of individual screen cloth wires. You get longer service because Hewitt-Robins utilizes a full range of metals in its selection of wire to assure that each panel of screen cloth is matched to meet individual job requirements. Types of wire range from genuinely oil-tempered through spring steel, stainless steel, enamel-coated and on to special alloys of extraordinary corrosion and heat resistant properties.

In specific installations where the more abrasive materials such as coke, iron ore, stone, gravel and coal are handled, specify Hewitt-Robins Super-Gyraloy. It's the specially treated oil-tempered wire that combines hardness—stiffness—elasticity—ductility—toughness . . . and must pass exacting laboratory tests for uniformity of these properties.

For operations involving a dust factor aggravated by moisture (as in sizing fine coke and iron ore) specify Hewitt-Robins Super-Gyraloy Enamel Coated Screen Cloth. The enamel coating prevents the build-up of the blinding compound . . . protects the surface against moisture and averts oxidation of the metal.

Where initial cost is of primary consideration and abrasion is not excessive, Hewitt-Robins Gyraloy® spring steel screen cloth provides maximum efficiency and economy. For special applications Hewitt-Robins Screen Cloth comes in plain or galvanized steels, brass, phosphor-bronze, Monel and other ductile alloys.

Hewitt-Robins Screen Cloth is available in standard production size openings from 3/16" and coarser . . . wire sizes from .105" diameter up to and including 1" diameter.

For complete information regarding the kind, type and opening of Hewitt-Robins Screen Cloth to best fit your operation . . . give you highest screening efficiency at lowest cost per ton . . . contact Hewitt-Robins Incorporated, Robins Conveyors Division, 270 Passaic Avenue, Passaic, New Jersey, or your nearest Hewitt-Robins representative.

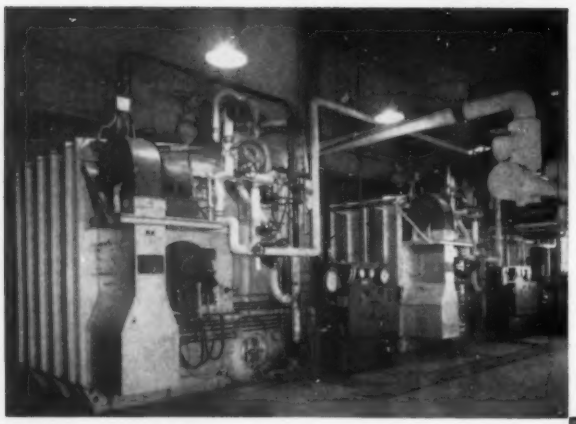
HEWITT HR ROBINS

Executive Offices, Stamford, Connecticut

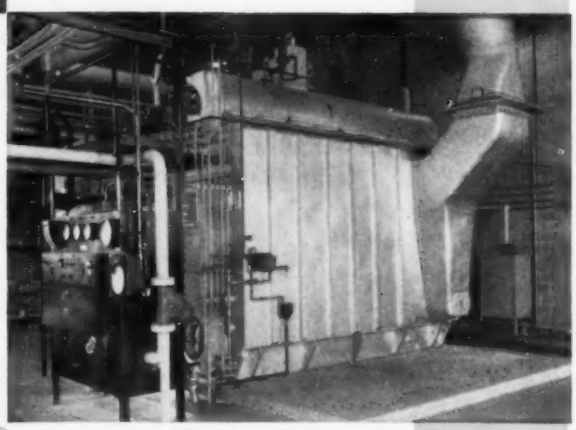
DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam

FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • **EXPORT DEPARTMENT:** New York City.

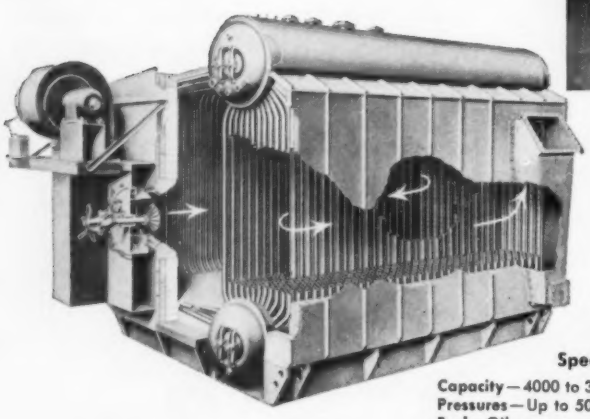
WHY ARE THEY



Industrial installation in the Midwest. Two VP Boilers. Capacity — 28,000 lb steam per hr each at 225 psi.



This VP Boiler serves a sewer pipe manufacturer in California. Capacity — 20,000 lb steam per hr at 215 psi.



Specifications — VP Boiler

Capacity — 4000 to 30,000 pounds of steam per hour
Pressures — Up to 500 pounds per square inch
Fuel — Oil or gas
Erection — Completely shop-assembled
Foundation — Simple concrete slab

BUYING VP Boilers ?

There's good reason for the fact that so many buyers of package boilers are finding that the VP offers them more for their money. For only in the VP will you find such significant *extra* features as—more water-cooling area per unit of furnace volume than any other boiler of its class . . . simple arrangement of baffles for maximum heat transfer . . . large lower drum for good accessibility and easy handling of load swings . . . quiet centrifugal fan, with less than half the noise level of typical high-speed blowers used on most other package boilers.

Little wonder then that VP purchasers range from small companies to some of the largest in the country . . . industrials of all kinds . . . schools and institutions . . . various government agencies . . . even the Atomic Energy Commission. These users are employing VP Boilers for all types of applications—heating, process, and even power generation.

Make sure then that you have details of the VP at your fingertips when next you are in the market for a boiler of moderate capacity. Ask for the new Catalog VP-104, which contains specifications and general information on dimensions, space requirements, construction details and controls.

INDUSTRIES USING VP BOILERS

Asphalt • Automobile • Canning • Chemical • Electrical Equipment • Enameled Products Essential Oils • Fish Oils & By-Products • Food • Housing Projects • Institutions Laundries • Metal Working • Mining • Paper • Petroleum • Printing • Railroad • Rubber Sewer Pipe • Textile • Utility • U.S. Atomic Energy • U.S. Air Force • U.S. War Department Wax Products

B-748

COMBUSTION ENGINEERING, Inc.

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

"All day I watch the coal go by!"

"Train after train. Day and night. Year after year. You wonder where it all comes from and how long it can last."

• • • • • • • •

You're right, Pop, it's a lot of coal—close to half a billion tons a year. Yet, in the more than a century this country has been mining coal, we have used up only a little over one percent of our known supply. 98.8% of the coal that nature put under our soil is still there for future generations.

That is something to think about when you are considering a new heating plant for home or industry. Other fuels will be getting scarce. Every year the wells go deeper. More and more of our fuel oil comes from foreign fields. Growing scarcity can mean uncertain supply and higher relative prices.

Coal you can be sure of. There will be a plentiful supply for many centuries to come. And the price advantage that makes coal a most economical fuel today is likely to grow with every passing year.

COAL
FUEL OF THE FUTURE

Chesapeake and Ohio Railway

Bring your fuel problems to C&O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

Write to:
Coal Traffic Department
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2115 Terminal Tower
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the complete line FOR ALL YOUR NEEDS

YOU CAN specify TUBE-TURN Welding Fittings and Flanges and know that you will get the *exact* answer to your specific piping problem. This leading line includes more than 4,000 items, in all piping materials . . . carbon steels, non-ferrous metals and alloys . . . schedules and sizes to match *your* design.

Carbon steel elbows, for example, are available from ½" to 42" diameter. Your nearby Tube Turns' Distributor provides this *complete* line promptly and backs it up with the thorough Engineering Service and how-to-do-it information of Tube Turns.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Toledo • Chicago • Denver • Los Angeles San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

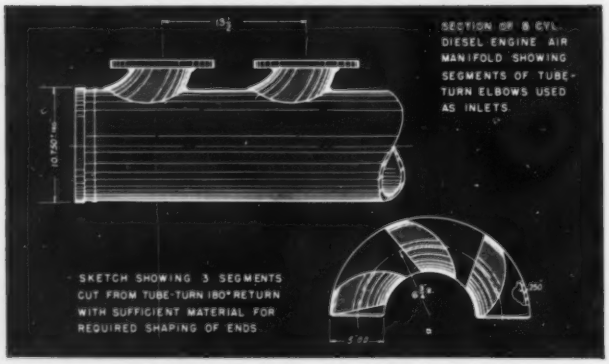
ENGINEERING SERVICE

Here's *Service* to help you solve your piping problems

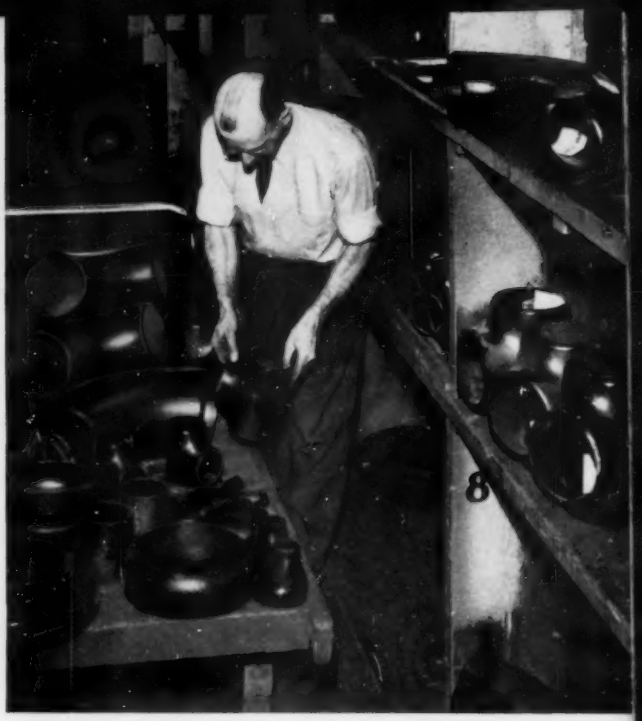
TUBE TURNS' Engineering Service Division makes available a vast fund of experience for the solving of design and operating problems in piping. For example:

An engine builder was fabricating manifolds from formed plate. Poor fitup was a problem and costs were excessive. Tube Turns' engineers suggested using TUBE-TURN Welding Returns, cut with templates as shown in the sketch. Costs came down. The dimensional uniformity of TUBE-TURN Welding Returns and Elbows simplifies fabrication jobs such as this because they can be cut to odd angles and adapted to special requirements.

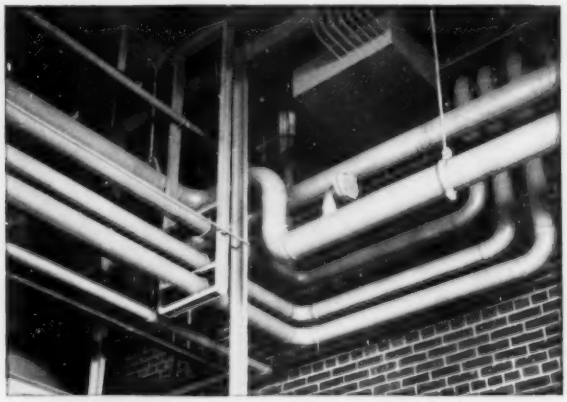
TUBE TURNS IS AT YOUR SERVICE!


SECTION OF 8 CYL. DIESEL ENGINE AIR MANIFOLD SHOWING SEGMENTS OF TUBE-TURN ELBOWS USED AS INLETS.
SKETCH SHOWING 3 SEGMENTS CUT FROM TUBE-TURN 180° RETURN WITH SUFFICIENT MATERIAL FOR REQUIRED SHAPING OF ENDS.

Header connection design problem solved by Tube Turns' Engineering Service.



YOUR NEEDS in welding fittings and flanges are met *promptly* by your Tube Turns' Distributor. This one reliable source can fill *all* your requirements from the world's most complete line of welding fittings and flanges comprising more than 4,000 items.



MANY USES. Piping in this modern edible oil plant conveys natural gas, hydrogen, oil, steam, cooling water, refrigerants, air and vegetable oil. All critical lines are welded and TUBE-TURN Welding Fittings are used for directional changes. Pipe sizes vary from 2" to 16".

Want Piping Information?

TUBE TURNS is recognized the world over for its leadership, not only in the field of welding fittings and flanges, but as a source of authentic information on piping design.

TUBE TURNS, Dept. C-3
224 East Broadway, Louisville 1, Kentucky

Please send me free copy of Pipe and Fittings Materials.

Company Name _____

Company Address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

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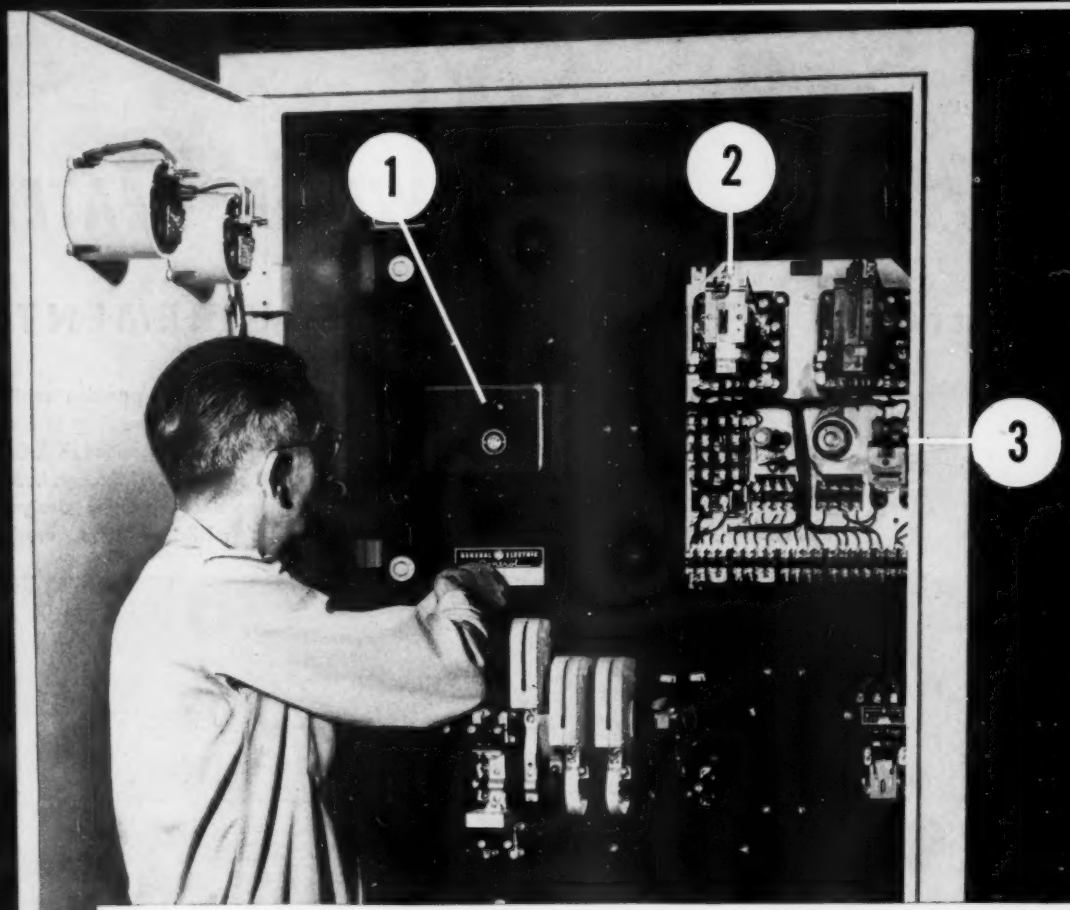
"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A DIVISION OF NATIONAL CYLINDER GAS COMPANY



Only G.E. Gives You These 3 Features in Standard Synchronous Motor Control at No Extra Cost

1. GRADUATED SQUIRREL-CAGE PROTECTION Relay protects motor during stall or subsynchronous operation. Protects squirrel-cage winding against overheating.

2. PRECISION ANGLE SWITCHING Field application relay takes fullest advantage of motor's synchronizing ability—applies field at correct speed and most favorable angle between rotor and stator poles.

3. LOAD ANGLE FIELD REMOVAL Fastest field removal available assures long motor life. Power-factor relay removes field within first half slip cycle out of synchronization.

You get these and other big features in *standard* G-E synchronous motor control at no extra cost. Be sure to get complete details—contact your nearest G-E Apparatus Sales Office or use the convenient coupon to get our new 16-page descriptive bulletin.

Section M 780-3
General Electric Company
Schenectady, N. Y.

Please send me your new bulletin, GEA-5873 which gives complete information on G-E Synchronous Motor Control.

Name.....
Position.....
Company.....
Address.....
.....

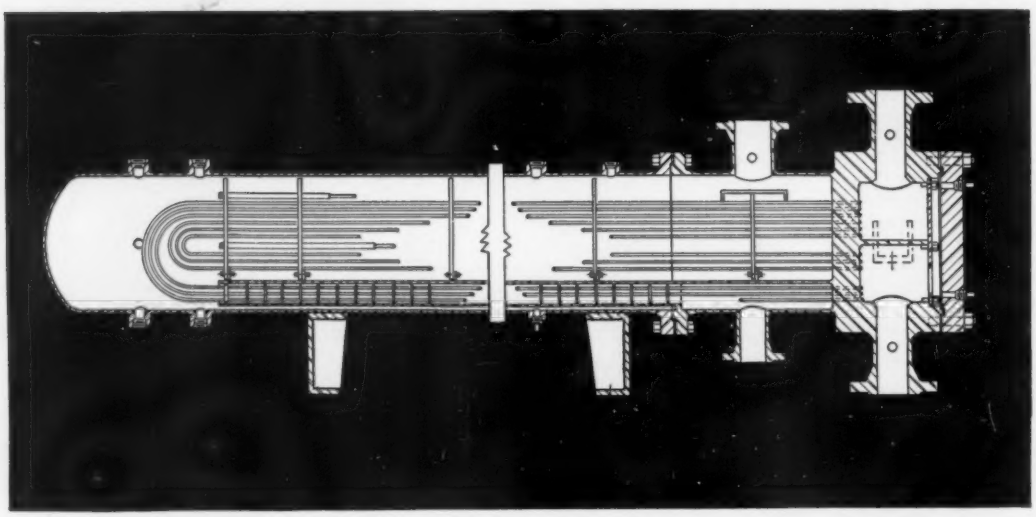
GENERAL ELECTRIC

SUPERIOR FEEDWATER HEATERS

are BUILT to *YOUR* REQUIREMENTS

Superior's flexibility in the design of heads, shells, and tube bundles provides tailored units to meet every feedwater heating requirement. Any combination of desuperheating, condensing, or subcooling in a single heater.

Leak-proof pass partition sealing plates using pressure drop of feedwater to insure a positive seal. Controlled steam travel through heater by means of specially designed baffles minimizes tube erosion.



DESIGNED FOR MAXIMUM THERMAL EFFICIENCIES

The illustrated typical Superior feedwater heater incorporates the most modern features of design. The unit is one of a pair recently supplied a large user of feedwater heaters. The tube design pressure is 850 p.s.i.

The integral subcooling zone cools the drips to a temperature close to that of the incoming feedwater. This increases the thermal efficiency of the heater and reduces the flashing of the drips to the next lower heater, thereby minimizing the erosive effect on both the interconnecting piping and the tube bundle.

The pass partition plate in the head uses the pressure drop of the boiler feedwater through the tubes to prevent leakage between passes and thus increases the thermal efficiency.

Our Engineering Department invites your inquiry on any proposed application as a basis for a specific engineering recommendation. Write for catalog 6010.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
HEAT EXCHANGERS

here's how high temperature piping can flex its muscles

Each pipe hanger is scale tested to rigid tolerances by a skilled workman at the Navco plant. After final assembly and inspection, the hangers are carefully crated and readied for shipment.

NAVCO *Counterpoise* Pipe Hangers

Since high temperature piping has no respect for equipment connections, the entire piping system must flex its muscles to absorb the strain of expansion and contraction. This prevents serious stresses that could endanger the installation.

And how does high temperature piping flex its muscles? With Navco's precision engineered Counterpoise Pipe Hanger—the hanger with a load-supporting effort that is of constant value throughout the range of travel. This permits weightless movement of the entire piping system.

To learn how power plants, oil refineries and chemical plants can have piping systems that flex their muscles, write today for Navco's 12-page Counterpoise hanger bulletin #153.

NAVCO

NATIONAL VALVE & MANUFACTURING COMPANY

3105 LIBERTY AVENUE, PITTSBURGH 1, PENNSYLVANIA

New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati

FUEL SAVING
HAGAN
automatic control systems
HAGAN
ring balance instruments

is our business

The primary purposes of every installation of Hagan Automatic Combustion Control and Instrumentation are to save fuel, and to provide the indications and records which guide the operators in maintaining maximum efficiency.

Each component of a Hagan System is selected to perform a specific function accurately and dependably, and to coordinate smoothly with all other related components in the system.

Back of every system, irrespective of size, there are more than thirty-five years of experience in development, design and application of Automatic Combustion Control and Instrumentation. As a result, Hagan Systems are easy to install, easy to calibrate and easy to keep in topnotch operation.

These typical applications emphasize the versatility of Hagan equipment and Hagan methods:

- Automatic combustion control systems for boilers of any size and pressure, burning all types of fuels, singly or in multiple.
- Boiler drum water level control, with automatic correction available for such factors as boiler load and boiler water density.
- Automatic control of gas and air temperatures for air preheaters.
- Draft and pressure controls for a continuous range from high vacuum to 5000 psig.
- Superheated steam temperature control.
- Pressure and temperature controls for feedwater heaters.
- Recording, indicating and totalizing flows of liquids, vapors and gases. Interchangeable sensing elements are available for full scale differentials from 1″ to 560″ WC.
- Simultaneous records of two separate flows, measured in a single meter housing. Flows may be added or subtracted.
- Pressure and temperature compensated records of steam and gas flows.
- Density compensated records of liquid flow or level, or for gas flows.
- Pneumatic and electric signal transmitters.
- Flow ratio control for liquids and gases.

Our engineers will be glad to suggest the Automatic Control and Instrumentation to fit your requirements.

Hagan Corporation

HAGAN HALL BUROMIN CALGON

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Automotive and Aeronautical Testing Facilities

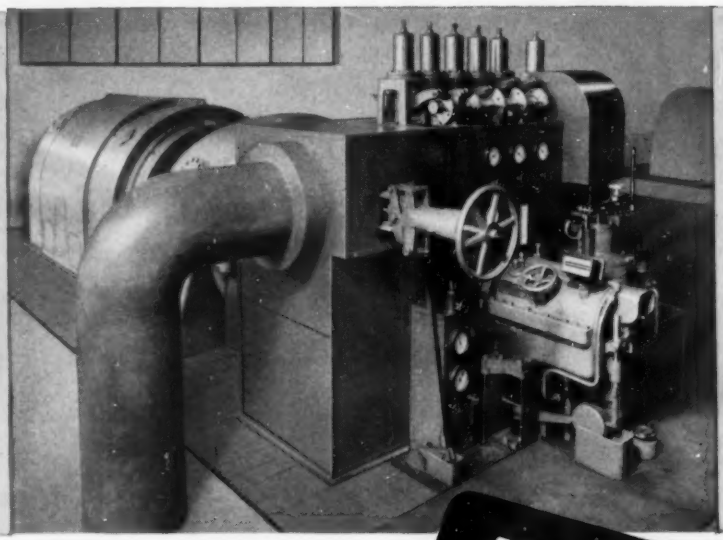
How a Southern Paper Company

Cuts Power Costs Three Ways

1
Eliminates Tube Failure

2
Reduces Maintenance

3
Cuts Blowdown Requirements



Main turbine room contains five turbine-generator units. You can get complete information on silica removal by writing for a copy of Bulletin 28R7135.

In a 33-month period, a southern paper company replaced 133 tubes and welded others. Now, after installation of Allis-Chalmers water conditioning, tube failures have been completely eliminated — along with virtual elimination of unscheduled maintenance. In addition, boilers have operated at top rating and efficiency for 12 months between scheduled cleanings. Blowdown requirements have become approximately half what they were before.

ALLIS-CHALMERS
WATER CONDITIONING
Equipment — Chemicals — Service

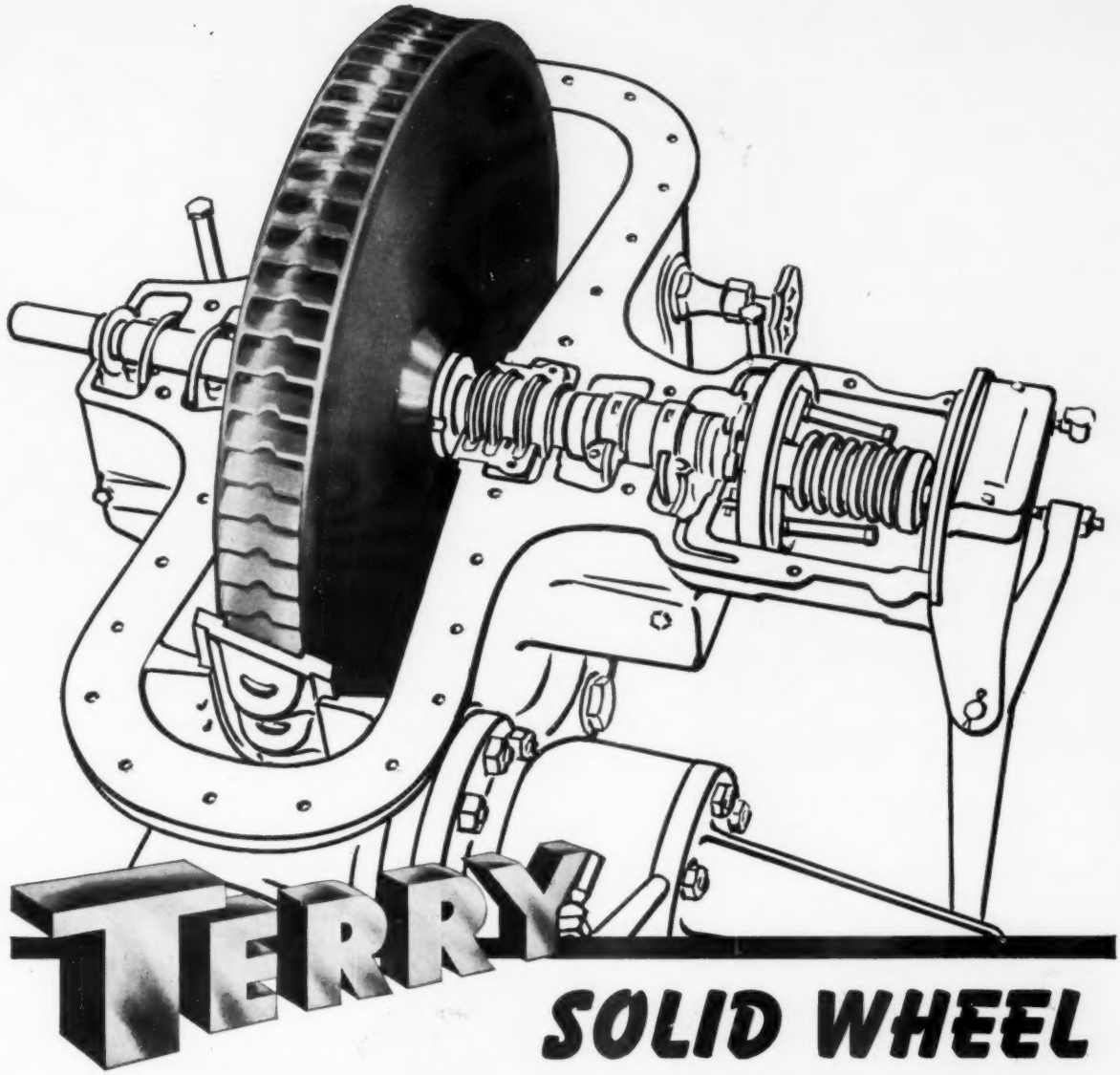
Remove Silica Content in Boiler Water

The job was done by reducing silica content 94% through use of a water conditioning system designed by Allis-Chalmers water conditioning experts. Before installation, silica content averaged 43.6 ppm. Now it averages 2.7 ppm. Equipment includes a 24,000-gph hot process softener, three 10-ft *Anthrafilt* filters, a surge tank, and chemical feeder. The system has been improved since original installation by the addition of a secondary hot phosphate unit.

How You Can Solve Your Water Problems

For any water problem, you'll find Allis-Chalmers chemicals, service, and equipment a useful addition to your power or process water application. Years of experience combined with a complete line of equipment enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4200

ALLIS-CHALMERS



SOLID WHEEL RUGGEDNESS

is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

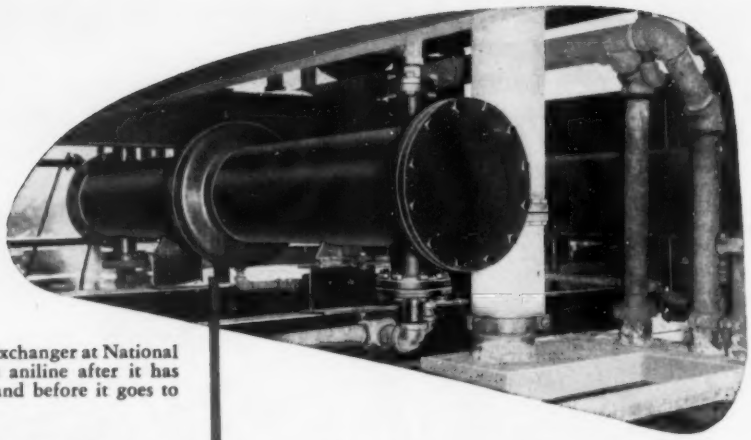
The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TT-1198



• ADSCO Heat Exchanger at National Aniline sub-cools aniline after it has been condensed and before it goes to storage.

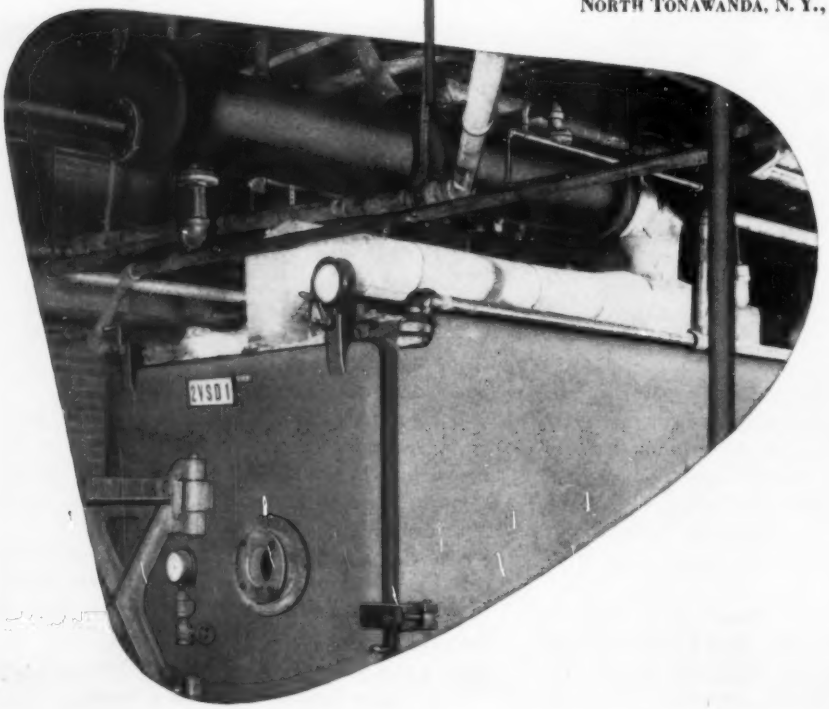
WHERE A HEAT EXCHANGER MUST BE GOOD

• ADSCO Heat Exchanger (insulated) above vacuum drier at National Aniline condenses organic acid vapor in tubes with water or brine in shell. Exchanger equipped with shell expansion joint.

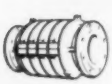
The ADSCO Heat Exchangers shown on this page are installed in the Buffalo, N. Y., plant of the National Aniline Division of Allied Chemical & Dye Corporation. The manufacturing processes of National Aniline require engineered equipment of the highest caliber. . . . ADSCO, in business since 1877, offers the chemical processing industry a complete line of carefully-engineered heat exchangers built to customers' specifications or to our recommended designs. Inquiries are cordially invited.

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS
NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.



ADSCO ENGINEERED PRODUCTS



EXPANSION JOINTS

TRAPS

STRAINERS

SEPARATORS

G-E Motors Are Custom-built for Power Station Service!

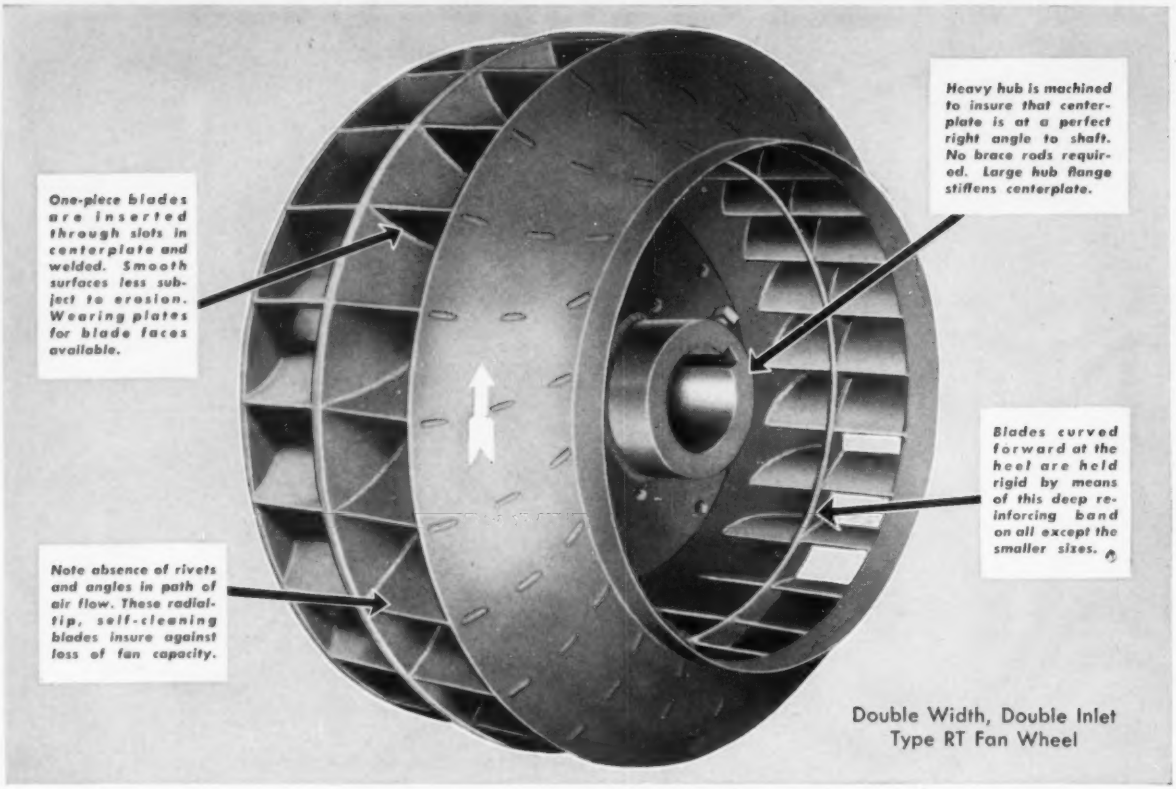
OUTDOORS OR IN, General Electric power station motors are built to give you dependable, economical service. For example, the two vertical Tri-Clad* totally enclosed fan-cooled motors, shown here, have given consistent reliable performance under all weather conditions at the A. B. Paterson Steam-Electric Generator Station of New Orleans Public Service Inc.

GENERAL ELECTRIC'S 70 YEARS of experience in designing, building, and servicing motors for power station requirements assures you of getting the right motor for the job. Whatever your needs in power station motors, G.E. can furnish a complete line including dripproof, totally enclosed fan-cooled, totally enclosed air-water cooled, and weather protected motors in both horizontal and vertical construction.

FOR MORE DETAILED information on G.E.'s power station motors, contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, New York.* 830-1

*Registered Trade-mark of the General Electric Company

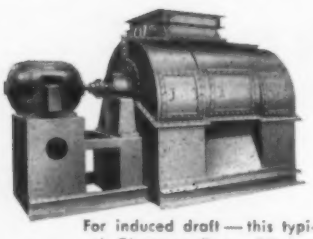
GENERAL ELECTRIC


One-piece blades are inserted through slots in centerplate and welded. Smooth surfaces less subject to erosion. Wearing plates for blade faces available.
Heavy hub is machined to insure that centerplate is at a perfect right angle to shaft. No brace rods required. Large hub flange stiffens centerplate.
Blades curved forward at the heel are held rigid by means of this deep reinforcing band on all except the smaller sizes.
Note absence of rivets and angles in path of air flow. These radial-tip, self-cleaning blades insure against loss of fan capacity.

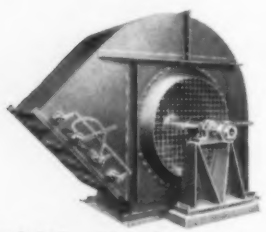
Double Width, Double Inlet
Type RT Fan Wheel

Note these points of superiority

which distinguish CLARAGE's Type RT wheel



For induced draft — this typical Clarage Type RT fan.



For forced draft — this typical Clarage Type RT fan.

Choose Clarage mechanical draft equipment and first cost is your last cost for a long time to come. An important consideration.

Throughout, the Type RT fan is distinguished by **heavy construction.** It's built to defy the most punishing demands.

Of special importance is the superior wheel. Here, particularly, is where Clarage construction is vital to you.

In many other respects the Type RT fan is a "stand out." Learn about these distinguishing features in Catalog 901, or contact the nearest Clarage application engineering office.

Applications, specifications, and available arrangements are covered in this catalog. Send for your free copy today.

You can Rely on...

CLARAGE

Headquarters for
Air Handling and
Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

2 New Services from Crane

How to Choose the Right Valve for Each Piping Job

HOW TO GET THESE FREE HELPS

Easiest way: phone your local Crane Representative—let him schedule a film showing for your group and supply the "take-home" handbooks. If more convenient, just drop a line to the address below.

Men responsible for specification, operation, and maintenance of industrial piping systems will get a real "refresher" from these new Crane customer services. Both film and handbook deal with the common problems of matching up valve characteristics and specific flow control needs for the most efficient result.

Following a review of basic valve types—gate, globe, angle, and check—variations in design of functional parts, and the effects on serviceability are discussed. All vital elements—disc and seating—disc-stem connection, bonnet joint, stem operation, etc., are covered. The motion picture stimulates high interest by developing a hypothetical case involving strong differences of opinion on valve selection. The manual—intended for distribution at film showings or for independent use—provides a lasting reference.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

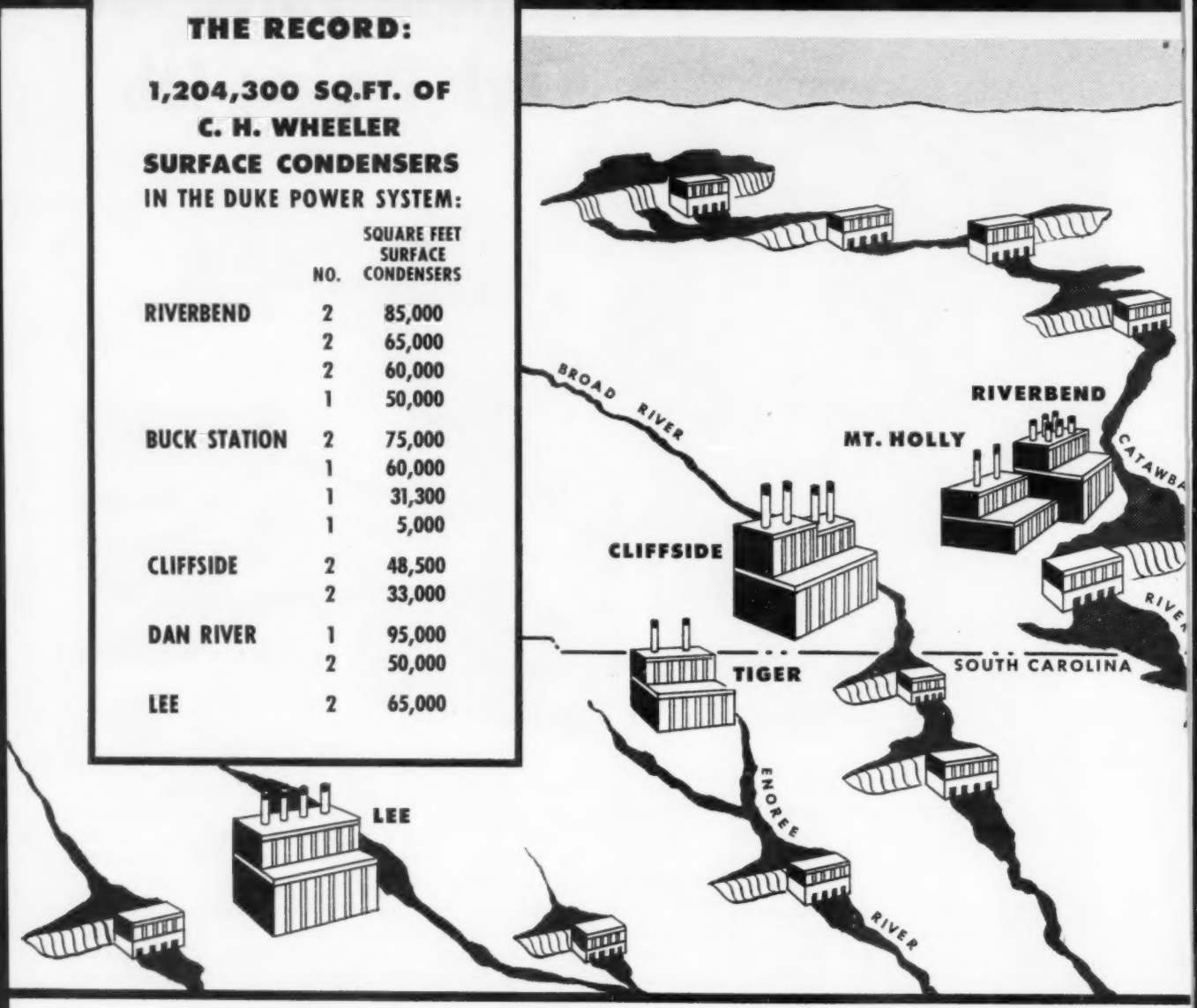
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

DUKE POWER *picks*

THE RECORD:

1,204,300 SQ.FT. OF C. H. WHEELER SURFACE CONDENSERS IN THE DUKE POWER SYSTEM:

	NO.	SQUARE FEET SURFACE CONDENSERS
RIVERBEND	2	85,000
	2	65,000
	2	60,000
	1	50,000
BUCK STATION	2	75,000
	1	60,000
	1	31,300
	1	5,000
CLIFFSIDE	2	48,500
	2	33,000
DAN RIVER	1	95,000
	2	50,000
LEE	2	65,000

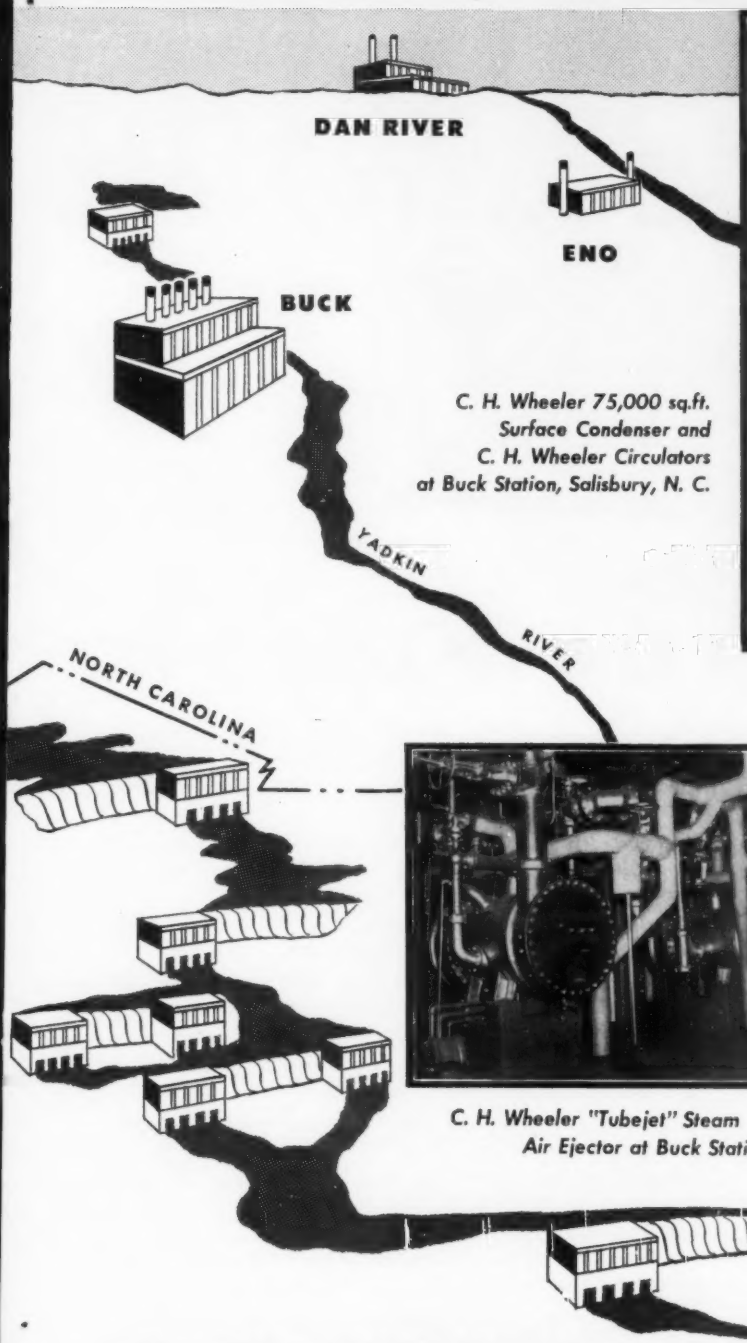


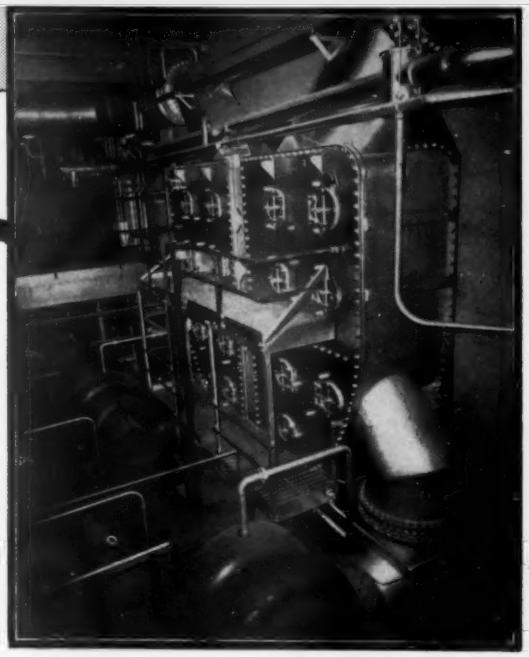
C. H. Wheeler Steam Condensers, Air Ejectors, Circulating and Condensate Pumps are tried and trusted equipment in every new steam power generating station that Duke Power has built. Photos show some of the latest installations in the new Buck Station where five C. H. Wheeler Surface Condensers are installed, ranging in size from a 5000 sq.ft. house turbine unit to a 75,000 sq.ft. unit. All other steam stations on the Duke system are completely equipped by C. H. Wheeler. This equipment is designed to strike a sound balance between first cost, operating efficiency and maintenance costs.

There's progressiveness in C. H. Wheeler engineering that matches the expansion plans of a great utility like Duke Power. A new 95,000 sq.ft. Surface Condenser Unit and auxiliaries is now being manufactured for Dan River Station.

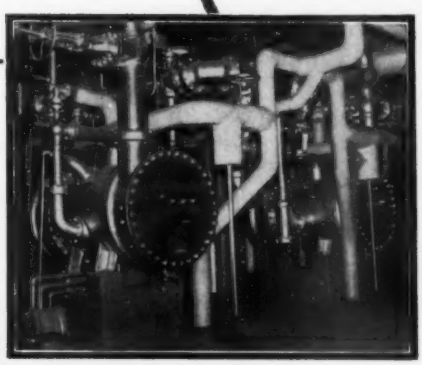
The art of condensing steam and producing vacuum for the prime movers of industry has the seasoning of 50 years of development at C. H. Wheeler. You can find no richer experience . . . no greater vision for the future of steam power generation . . . than at C. H. Wheeler of Philadelphia. . . . ***HOW MAY WE HELP YOU?***

C. H. WHEELER
STEAM CONDENSERS—AIR EJECTORS
CIRCULATING AND CONDENSATE PUMPS

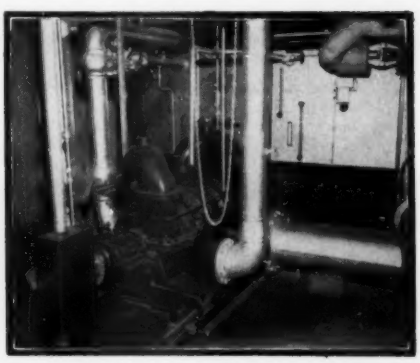




C. H. Wheeler 75,000 sq.ft. Surface Condenser and C. H. Wheeler Circulators at Buck Station, Salisbury, N. C.



C. H. Wheeler "Tubejet" Steam Air Ejector at Buck Station

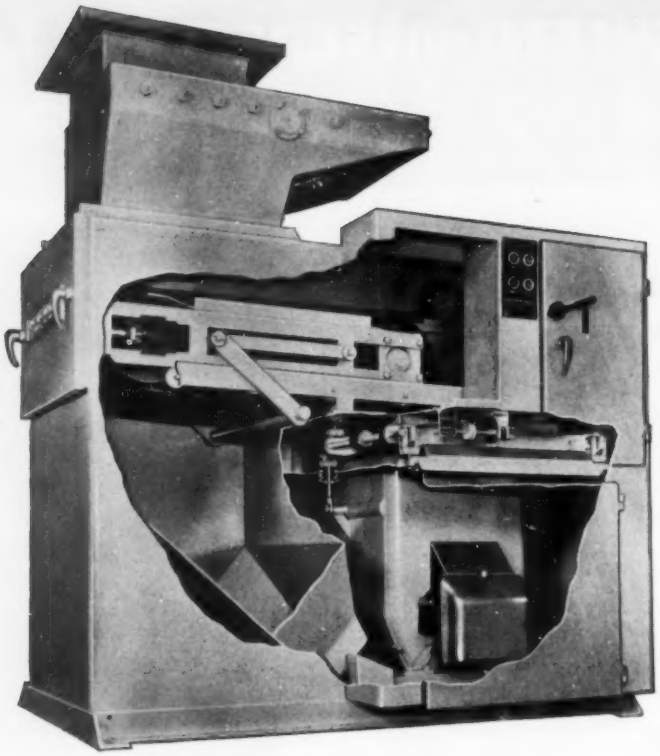


C. H. Wheeler 5-stage Condensate Pumps Operating on a Split Cycle System with a balancing standpipe between stages

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration
High Vacuum Process Equipment • Micro Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery



Maintenance Men Know the Inside Story

The unique design of the feeder frame, as shown below, provides an easy and quick means of changing an endless belt. This can be done without interrupting flow of coal to the boiler.

When maintenance men work with S-E-Co. Automatic Coal Scales, they know that they are working with equipment designed and built to give continuous service and which requires an absolute minimum of attention.

Maintenance men are well aware that the following time and trouble-saving features included in the S-E-Co. Coal Scale will mean better scale performance for your plant:

1. Neoprene rubber feeder belt that is molded endless — offering maximum in long life expectancy.
2. Rigid feeder frame, mounted on rollers, specifically designed for easy removal from scale body and quick changing of feeder belt (See photograph to left.)
3. Electric counter with no linkage connections to get out of adjustment, cause errors, or need maintenance attention.
4. Large hinged and latched, dust-tight doors which facilitate maintenance by providing easy access to any part of the scale.
5. Electric circuits wired through terminal block, allowing easy check of any or all circuits at one point.

Write for Coal Scale Bulletin No. 61 or for our local representative to call and discuss the application of the S-E-Co. Coal Scale and related equipment to your particular plant problem.

STOCK EQUIPMENT COMPANY
745-P HANNA BUILDING CLEVELAND, OHIO

Specialists in Bunker to Pulverizer and Bunker to Stoker Equipment

ALL FORGED STEEL

Edward UNIVALVES

Lower Pressure Drop 25-50% with Straight-Thru Flow

As shown photographically here, the streamlined internal contours and the inclined stem construction of the Edward Univalve give straight through flow — which careful laboratory tests have shown to result in pressure drop 25 to 50% lower for Univalves than other globe valve types. Turbulence, too, is greatly lowered by these streamlined contours. And lowering turbulence lengthens valve life by eliminating vibration, the principal cause of wear in small globe valves.

But lower-pressure drop and less turbulence are not the only reasons the Univalve has become an industry standard for tough high pressure, high temperature services. Here are just a few of the benefits which add up to longer life and lower maintenance for this outstanding all Forged Steel Valve.

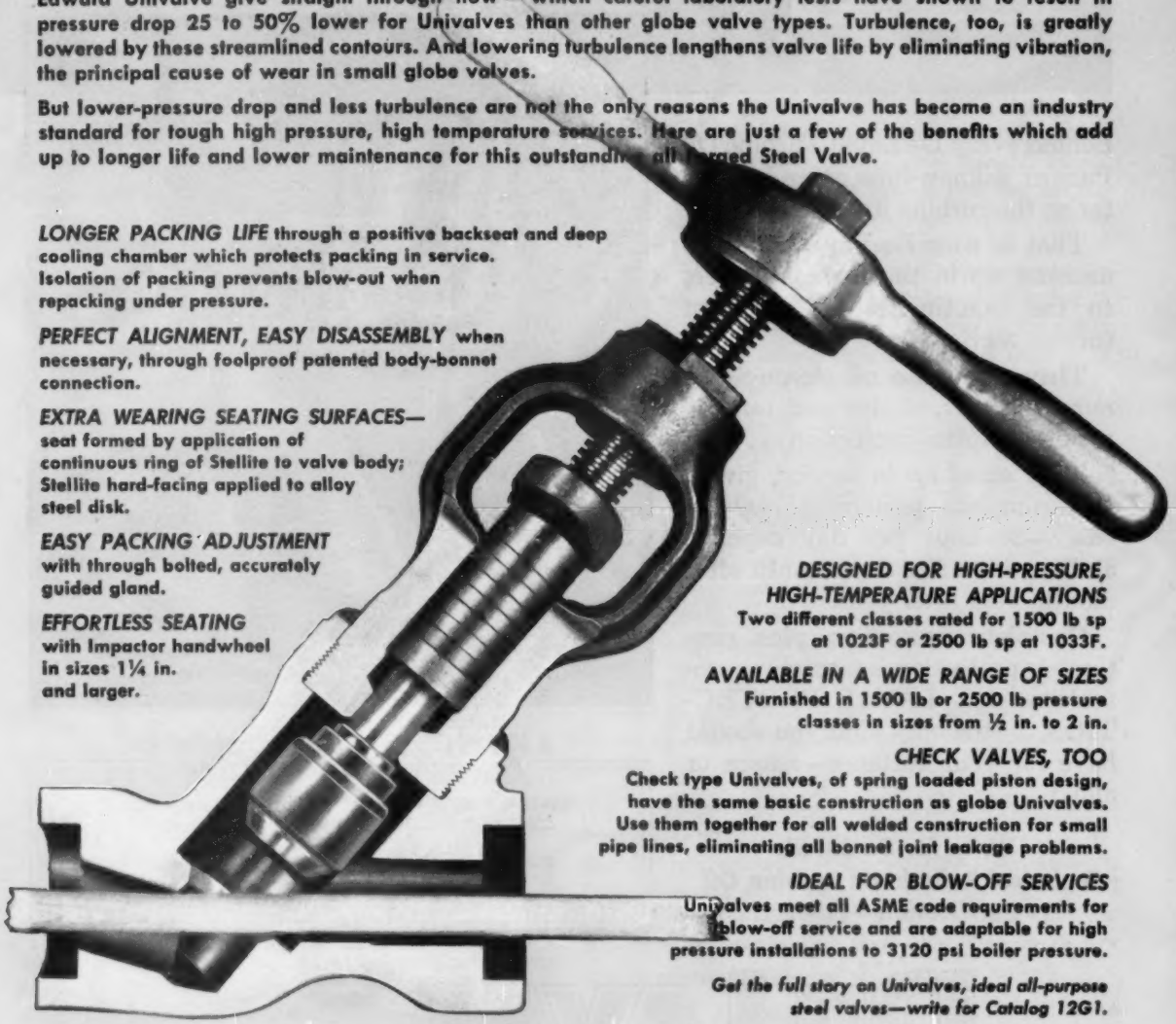
LONGER PACKING LIFE **through a positive backseat and deep cooling chamber which protects packing in service. Isolation of packing prevents blow-out when repacking under pressure.**

PERFECT ALIGNMENT, EASY DISASSEMBLY **when necessary, through foolproof patented body-bonnet connection.**

EXTRA WEARING SEATING SURFACES— **seat formed by application of continuous ring of Stellite to valve body; Stellite hard-facing applied to alloy steel disk.**

EASY PACKING ADJUSTMENT **with through bolted, accurately guided gland.**

EFFORTLESS SEATING **with Impactor handwheel in sizes 1¼ in. and larger.**



DESIGNED FOR HIGH-PRESSURE, HIGH-TEMPERATURE APPLICATIONS
Two different classes rated for 1500 lb sp at 1023F or 2500 lb sp at 1033F.

AVAILABLE IN A WIDE RANGE OF SIZES
Furnished in 1500 lb or 2500 lb pressure classes in sizes from ½ in. to 2 in.

CHECK VALVES, TOO
Check type Univalves, of spring loaded piston design, have the same basic construction as globe Univalves. Use them together for all welded construction for small pipe lines, eliminating all bonnet joint leakage problems.

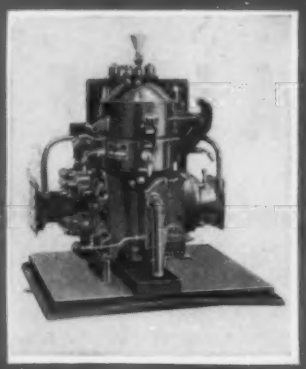
IDEAL FOR BLOW-OFF SERVICES
Univalves meet all ASME code requirements for blow-off service and are adaptable for high pressure installations to 3120 psi boiler pressure.

Get the full story on Univalves, ideal all-purpose steel valves—write for Catalog 12G1.

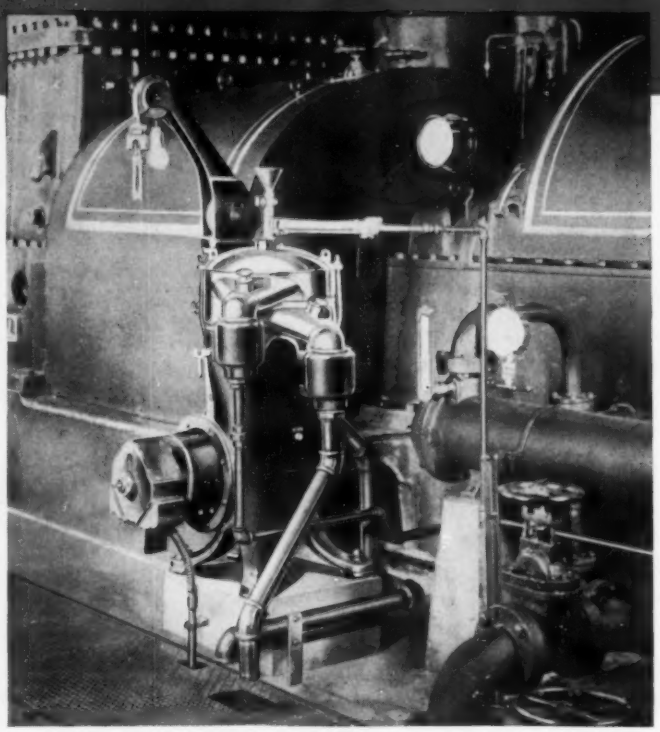
Rod through Univalve demonstrates straight thru flow of this valve.

Edward Valves, Inc.
Subsidiary of ROCKWELL MANUFACTURING COMPANY
1220 West 144th Street, EAST CHICAGO, INDIANA

Another Product



"DE LAVAL" MEANS "MAXIMUM PROTECTION" in Turbine Oil Purification



Behind every De Laval Turbine Oil Purifier is know-how going back as far as the turbine itself.

That is why De Laval Purifiers measure up in the highest degree, to the exacting requirements of turbine service.

They clean the oil *thoroughly*—removing dirt, sludge *and water*—giving complete protection . . .

They *stand up* in service, giving this complete protection *continuously*—24-hour per day dependability, day after day, month after month, year after year.

Complete protection plus continuous protection is maximum protection—DE LAVAL PROTECTION . . . the only kind you should have for your turbines—ashore or afloat.

Write for De Laval Technical Bulletin on Turbine Oil Purification—TU-1.

A Few of the Many Turbine Installations Protected by De Laval Oil Purifiers:

CENTRAL HUDSON GAS & ELECTRIC CO., Danskammer, N. Y.
CONSUMERS POWER CO., Comstock, Mich. and Erie, Mich.
DUKE POWER CO., Mt. Holly, N. C.
S.S. UNITED STATES • S.S. JOHN J. BOLAND
S.S. ESSO and five sister ships

DE LAVAL®

TURBINE OIL PURIFIERS

for More Dependable Power Production

THE DE LAVAL SEPARATOR COMPANY

Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5

IMAGINATION: Road to Success

IN EVERY AGE, creative imagination has been a high road to achievement, but it has not always paid cash on the barrel head. In past ages, smart people often starved in garrets. Not so today; viewed across the board, ours is history's greatest age of creative imagination—and the best paying.

Here are examples: In the theater, imagination gave us *Oklahoma, South Pacific, The King and I*—all wonderful creations and all profitable.

Creative imagination in physics has unveiled the mighty miracle of atomic energy—and produced several good jobs for every available physicist.

In electronics, creative imagination is sweeping the field, giving us color TV, the transistor, printed radio circuits, electronic bookkeeping and automatic factories.

In distribution, it has given us the modern chain grocery store. In transportation, the creative imagination of engineers and business men has given us the wonders of modern air travel—with more to come.

Strangest of all is the fact that creative imagination has, to some degree, even made imagination unnecessary. The application of scientific, technical and business imagination has produced such a flood of good things that the average man can live well on the overflow without contributing any original thought of his own.

Since this lush prosperity no longer requires us to exercise originality, merely to live, own a car and eat, why bother stepping out from the crowd? My answer is threefold: (1) To achieve greater things for their own sake. (2) To have more fun doing them. (3) To eat *better*. What more can you ask?

A lot of men in power engineering and other professional fields get by with little original thought, merely following along the lines that have worked out not too badly in the past. The fact that such routine workers hold their jobs year after year, and make a fair living at that, is proof that the world has comfortable berths for plodders who either lack originality or don't bother to exercise it. Just the same, the big rewards in the power field, and in every other field, will more and more go to those who add originality to basic competence.

By the way, here is a good place to pass along my formula for creative imagination:

1. *Start with a well-stocked mind*—in short, a good education plus a lot of practical experience.

2. *Unlock the doors.* Don't fear to let your imagination roam down untrodden paths into strange fields. If you stick to the traveled highways of the mind, you will discover only what everybody knows.

3. *Turn on the heat.* Good imagineering is rarely achieved in cold blood or for profit alone. Pioneering should be exciting. The dollar profit will come as a by-product.

4. *Screen the output to avoid dollar loss.* Any active imagination will turn up a lot of ideas that won't pay off. This fact need not worry you if you check every idea carefully before you get to the money-spending stage. By all means do this for self-protection, but don't make the mistake of over-conservatism. Don't slap down every new idea as soon as it sticks its head above the surface.

Above all, don't slap down the young man under you who comes up with new ideas. Give them a friendly reception. Don't kill the goose that lays the golden egg.

Now!...

An INTERRUPTING RATING in EXCESS of 100,000 AMPERES *for every set of fuse clips in your plant* . . . simply by installing FUSETRON *dual-element* FUSES

The Biggest Electrical Protection NEWS Since BUSS invented the FUSETRON Dual-Element FUSE

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

In 1947 tests made by the Electrical Testing Laboratories of New York, showed that on a circuit set to deliver 50,000 amperes, FUSETRON fuses in all tests cleared the circuit safely.

50,000 amp. Interrupting Capacity in 1947
becomes
100,000 amp. Interrupting Capacity Today

After years of intensive development work on FUSETRON fuses new tests were conducted under conditions that simulated the most severe field conditions and these tests were witnessed and verified by the Electrical Testing Laboratories of New York.

On circuits set to deliver in excess of 100,000 amperes, 30 to 600 ampere, 250 and 600 volt FUSETRON dual-element Fuses on each and every test cleared the circuit without belching flame or venting hot gases and with comparatively little noise.

Oscillograms of these tests interpreted by the Electrical Testing Laboratories, showed that the total available amperes including the direct current component, reached values as great as 165,000 peak amperes on 240 volt tests and as high as 212,000 peak amperes on the 535 volt tests.

This indicates that an interrupting rating of 100,000 amperes for FUSETRON dual-element fuses is a conservative one.

No interference with time-lag

In the development work to increase interrupting capacity in FUSETRON fuses it was kept in mind that the time-current characteristic must be maintained. Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses.

Remarkable results have been achieved. Interrupting capacity has been greatly increased while the time-current characteristic of FUSETRON fuses has in no way been disturbed.

Play Safe – install Fusetron Fuses throughout the entire electrical system!

Think!...

ALL THIS ADDED SAFETY *without changing a panelboard or switch... plus* 10 Point Protection of FUSETRON *dual-element* FUSES!

Maximum Safety

With FUSETRON Fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every FUSETRON fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to *pay extra* for "safe" equipment. Wherever a FUSETRON fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

When FUSETRON fuses have once been installed properly you can forget about them. They need no periodic inspections to see if they will operate safely.

Dust, fumes, corrosion or age cannot prevent a FUSETRON fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

With FUSETRON fuses — you get safety — without one cent spent for inspection or maintenance costs.

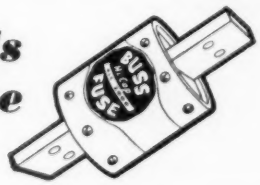
No Recalibration Costs

When a FUSETRON fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS— a fuse that is as safe and dependable as the one that blew.

PLUS 10 POINT Protection with FUSETRON dual-element FUSES

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

for SAFE PROTECTION on loads above 600 and up to 5000 Ampere install BUSS Hi-Cap FUSES



Tests have shown that BUSS Hi-Cap fuses have unlimited interrupting capacity on circuits of 600 volts or less.

They are designed to give protection against dangerous overloads as well as high fault currents — yet their speed of operation on heavy shorts limits currents to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with FUSETRON dual-element fuses they will not open ahead of the fuses nearest to the fault. Thus trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

ACTION THAT SAVES YOU MONEY

By passing the word along that all purchase and stock records should call for FUSETRON fuses on loads up to 600 amps—and BUSS Hi-Cap fuses on loads above that — you get action that begets money saving.

For blowing time charts or more information on FUSETRON Fuses and BUSS Hi-Cap Fuses write for Bulletins FIS and HCS.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. Division McGraw Electric Company

Here's why CORROSION COSTS YOU MORE than WROUGHT IRON

IT TAKES ONLY **ONE** TO INSTALL PIPE...

BUT **FIVE** TO REPAIR IT!

One of the most convincing demonstrations of the economy of using *durable* material is a pipe repair job where low-first-cost material has failed—and is being replaced.

The original installation had been quickly made by plumbers. But the replacement calls for hours of work by as many as five crafts: plumber, mason, plasterer, carpenter, painter. Often, maintenance is billed at overtime rates. And this is only part of the cost story. Production slow-down, disrupted routine may amount to far more than the maintenance charges.

Fortunately there's an answer to pipe durability in corrosive services—Byers Wrought Iron pipe. In literally thousands of applications where corrosion is a threat, the use of this material has proved the soundest kind of economy move.

The next time you specify or approve pipe, you'll find it profitable to investigate the durability records of wrought iron.

Our bulletin, "The ABC's of Wrought Iron," gives the what, why and where of this material. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, New York.

Remember—
the pipe that lasts
the longest
costs the least!

FOR PRODUCTION CONTINUITY LOWER MAINTENANCE— Insist on Byers WROUGHT IRON PIPE

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

a **Power** handbook

HEAT EXCHANGERS

By B G A Skrotzki, *Associate Editor* and S S Waldron, *Assistant Editor*

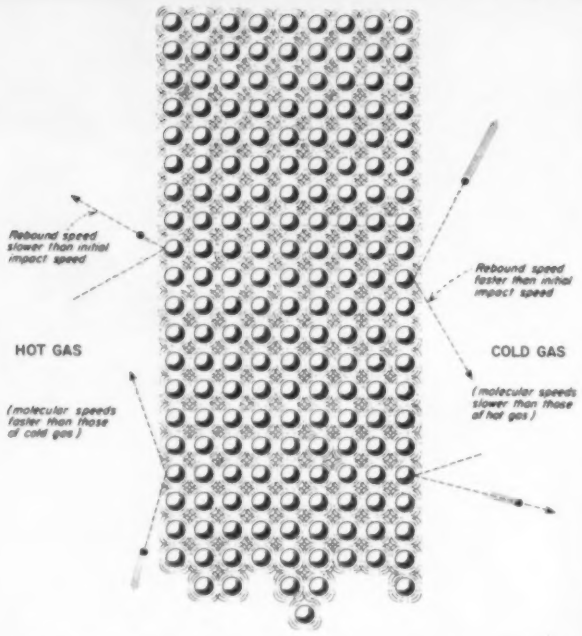
In power plants and throughout industry we're always aware of the rotating machines that *transform* energy —the motors that turn electricity into shaft power, the pumps that turn shaft power into hydraulic energy, and so on. Much less conspicuous, but perhaps of greater importance, is the quiet *transfer* of energy that goes on in the units designed for efficient heat transfer—heat exchangers.

When you stop to think about it, the array of such units is vast—so vast, in fact, that when we planned this handbook we were forced to draw some boundary lines. So, we don't consider here boilers and other fired exchangers. Nor do we include specialized forms of heat exchangers, such as economizers, air heaters, gas-turbine regenerators, space-heating and air-conditioning units, all of which we have discussed in previous handbooks. We've also found it necessary to defer coverage of evaporative-cooling equipment — spray ponds, cooling towers, evaporative condensers, etc — for a later handbook section.

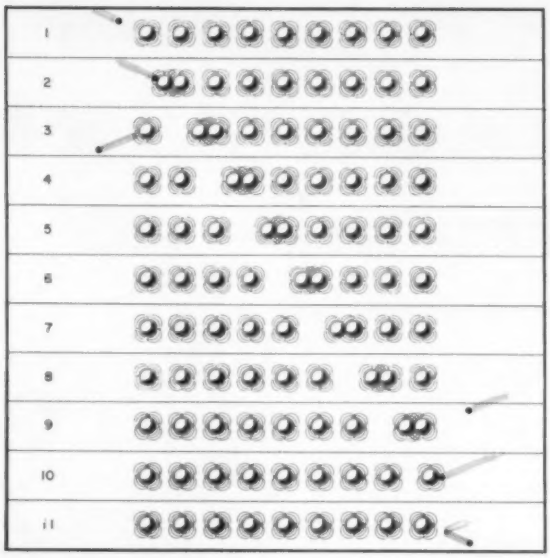
Thus we're able to concentrate here on the wide variety of shell-and-tube and contact exchangers, including such familiar types as feedwater heaters, steam condensers, evaporators, deaerators. With the unstinting help of specialists in the field, we've rounded up a fistful of practical information on fundamentals of heat transfer, and on construction and application of various heat-exchanger types.

Use this new POWER handbook to step up efficiency of the all-important heat-transfer jobs in your plant.

JUNE • 1954


Rebound speed slower than initial impact speed
HOT GAS
(molecular speeds faster than those of cold gas)
Rebound speed faster than initial impact speed
COLD GAS
(molecular speeds slower than those of hot gas)

1 Energy vibrations of molecules in a solid are raised by impacts from hot-gas molecules. On opposite colder face, contacts with slow-moving molecules reduce rate of vibration



2 Hot-gas molecule in (2) gives up some energy in hitting outer molecule of solid. This energy passes on by impact to neighboring molecules and finally to gas molecule in (10)

Heat transfer . . . *to understand it, take a . . .*

Heat exchangers, as the name implies, transfer heat from one substance to another. We can distinguish three basic ways of moving heat: (1) conduction (2) radiation (3) convection. In actual exchangers, all three usually come into play, in varying degrees.

Conduction. In most exchangers we have a metal wall or walls separating one fluid from another at a different temperature. Heat from the hotter fluid passes through the separating wall to the cooler fluid. This is really a mechanical molecular process, as shown in Fig. 1. Let's take a quick look.

Molecules in a solid (like the separating metal wall of the exchanger) act on each other with two kinds of forces (1) gravitational forces of attraction and (2) unidentified forces of repulsion. When the molecules are a certain distance apart, these two forces are in balance and the molecules hold their places with nothing but space between.

If outside forces try to stretch a solid, gravitational forces come into play, make the molecules resist being torn apart. When we try to compress a solid, repulsion forces (whose exact nature we don't know) make the molecules resist being pushed together.

Molecular Vibration. The molecules of a solid really only stand still at a temperature of absolute zero, about —459 F. As a solid warms up, its molecules shiver and vibrate in place with the heat energy they have absorbed. At low temperatures, vibration is sluggish, but as temperature goes up it gets more rapid. Thus temperature measures the molecules' vibration rate.

Unlike the molecules of a solid, gas molecules are free to move. They shoot about in random paths, moving faster at higher temperatures. In the simplified example of Fig. 1, we have a solid barrier between a hot gas and a cold gas. Swiftly moving molecules of hot gas strike surface molecules of the solid, giving up part of their energy in the slamming impact. This increases vibration of the solid's surface molecules; mutual attraction and repulsion forces pass this stepped-up activity along to the other molecules.

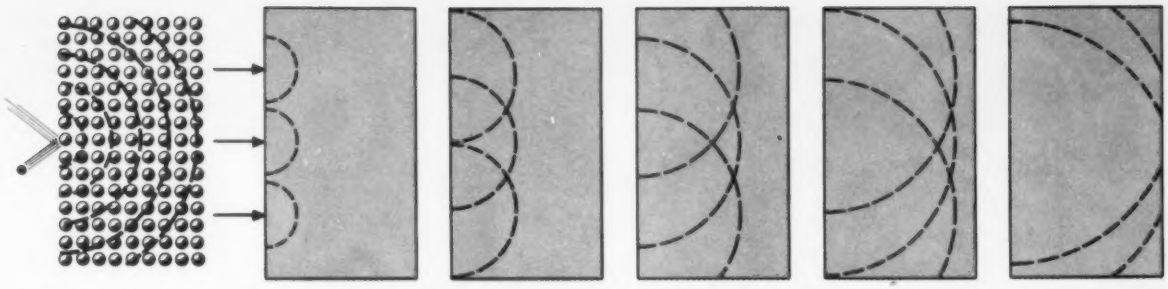
Energy Flow. Fig. 2 shows how energy given up by a hot-gas molecule might be passed along by molecules of a solid barrier to a cold-gas molecule on the other side. Impact from a gas molecule, however, travels in all directions through a solid, as shown by dashed arcs in left panel of Fig. 3. The shaded rectangles show how the "wave fronts" of heat energy might pass through a solid from the simultaneous impact of three molecules.

Actually, there are billions of molecules involved even in the smallest surface. And don't forget that each gas molecule makes billions of collisions each second, with its neighbors and with the solid molecules. So in our heat-transfer problems we are conscious only of the mass effect.

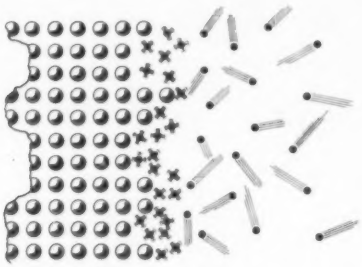
Fig. 4 shows one other effect that can be partly explained from the molecular standpoint. Slower gas (or liquid) molecules get trapped on the surface of a solid by the mutual forces of attraction. These trapped molecules form a thin film on the surface of the solid. Such films cause a temperature drop—we'll talk about its effects later.

The movement of heat *through* a substance is called *conduction.* The amount of energy moved, or the *heat transfer,* depends on (1) the temperature difference between the two faces of the substance (2) the area of the heat path, and (3) the nature of the substance. Before we start putting numbers on these relations, let's look at other modes of heat flow.

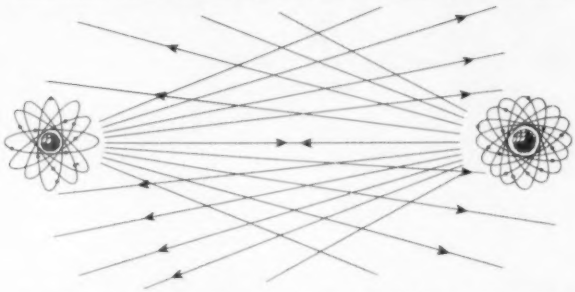
Radiation. We're all familiar with the radiant heat given off by the sun, by a fire or by a hot stove. This form of heat transfer takes place without aid of any substance between, will even work in a vacuum. Radiant heat originates from changes in activity between atoms of a molecule or within the atoms themselves. Any decrease in these activities sends out pulses of energy to other atoms, which step up in activity



3 Hit by single gas molecule causes vibration increases in all directions in molecules of solid. Dotted lines show advancing wave front of simultaneous hits by three molecules. Continuous bombardment by hot-gas molecules transfers heat



4 Gas molecules that get trapped on the surface of a solid form a thin film that reduces the rate of heat transfer



5 Radiant heat originates in the inner activity of molecules, sends energy pulses to other molecules some distance away

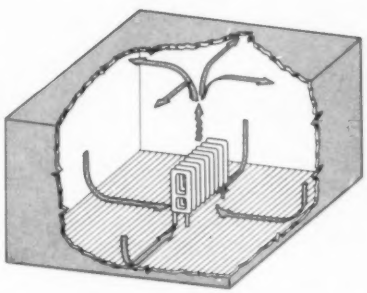
. . . look at the molecular motion that is heat . . .

correspondingly. Radiant heat plays a relatively minor part in the heat exchangers we'll discuss in following pages. It is highly important, of course, in fired equipment, such as boiler furnaces.

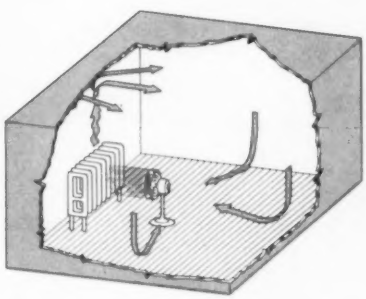
Convection. All around us we see examples of the third mode of heat transfer—convection. For example, Fig. 6 shows a common space-heating radiator standing in the middle of a room. Air between the radiator's elements is heated by conduction, expands and grows lighter than surrounding room air. This makes it float upward as colder air replaces it. Colder air is, in turn, heated and rises. So a continuous flow is set up over the heated surfaces.

The heated air rises to the ceiling and disperses. In its travel over the ceiling surface and walls it loses heat by conduction. The air becomes denser and sinks to the floor, eventually replacing the heated air rising from the radiator. This whole process is known as *natural convection* and occurs in liquids as well as gases. Note that it differs markedly from conduction (heat flow *through* a substance) and from radiation (wave-like energy pulses straight across air space). In convection, heat is carried by a moving gas or liquid.

Forced Convection. If we move the liquid or gas by a pump, fan or other device, instead of depending on the natural currents resulting from heating and cooling, we have *forced convection.* By forcing fluid to flow over the heat source at higher speed, we can raise the rate of heat transfer, within limits. And the faster forced flow of the fluid makes it possible to carry heat to where it's wanted at a greater rate.



6 In natural convection, heated gas rises from source to carry heat elsewhere

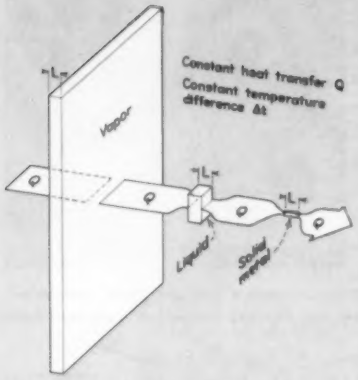


7 In forced convection, gas to be heated is forced to flow over heat source

In heat exchangers, convection is an important adjunct to conduction. The convection effect makes a fluid heated at a surface mix with nearby cooler fluid and, in turn, heat it. In addition, movement of the heated fluid from the heating surface allows a steady flow of cooler fluid to take its place and also become heated.

Heat Flow. In all cases the three forms of heat transfer are involved in varying degrees. Take a typical example: heat flow from a hot gas through a tube wall into a liquid. Heat is carried to the tube surface and transferred to the tube by a combination of convection, conduction and radiation. The latter effect is so small we can ignore it. Heat then flows through the wall by conduction to the inner face, and is transferred to the liquid by a combination of conduction and convection.

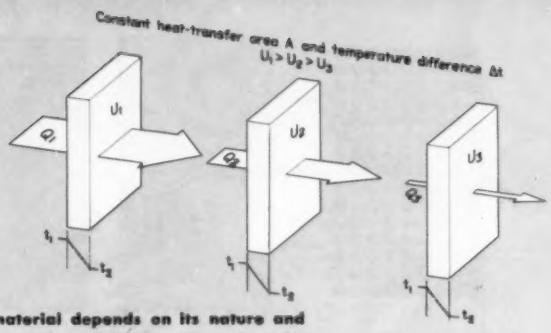
In heat flow by pure conduction there are three factors that control: (1) nature of the substance (2) difference in temperature of the two surfaces (3) cross-sectional area of the heat



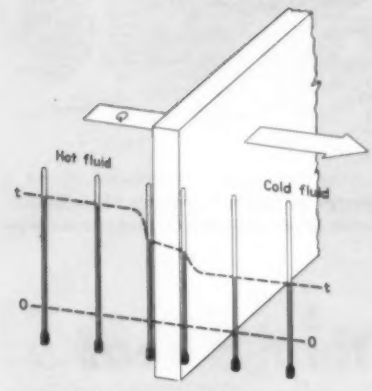
8 **Metals need least area to pass given heat, Q; vapors need largest area**

$$Q = U \times A \times \Delta t$$

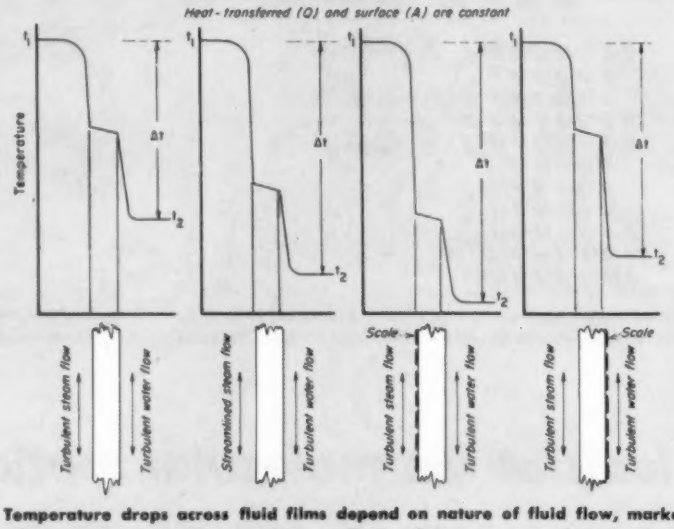
Q = total heat flow, Btu/hr
U = heat-transfer coefficient, Btu/hr/sq ft/F
A = area of heat-transfer surface, sq ft
Δt = temperature difference, F



9 **Heat transferred by a material depends on its nature and is measured by its heat-transfer coefficient (formula, *left*)**



10 **Fluid films adhering to surfaces of solid cause sharp temperature drops**



11 **Temperature drops across fluid films depend on nature of fluid flow, markedly affect temperature of separating wall. So does presence of scale deposits**

...then look at the ways heat flows, how that flow is measured...

path. The effect of the nature of the substance is shown in Fig. 8. With the same temperature drop between the two surfaces separated by same distance L, a small area of solid metal transmits as much heat as a vastly greater area of vapor or gas.

Heat-Transfer Formula. For conduction heat flow we can write a relatively simple formula: $Q = U \times A \times \Delta t$, where Q is total heat flow in Btu per hr, A is area in sq ft, and Δt is temperature difference between the two surfaces. Here U is a coefficient measuring the rate at which the substance involved conducts heat. Fig. 9 illustrates this: if three materials have the same cross-sectional area A, and the same temperature difference between their surfaces $\Delta t = t_1 - t_2$, the heat flow Q depends directly on transfer coefficients U_1, U_2 and U_3.

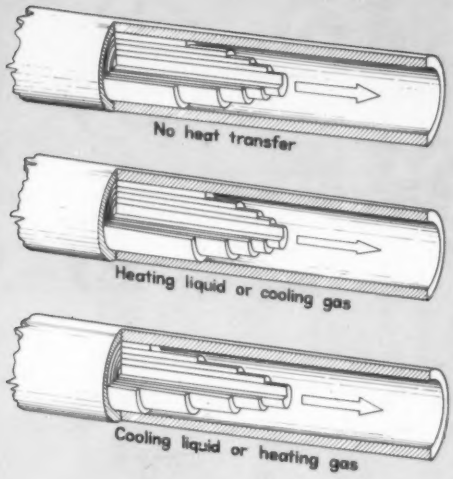
Film Temperature Drop. In Fig. 4 we showed that molecules get trapped as a stagnant fluid film on surfaces like those of the tube wall in the example above. These films cause a temperature drop from gas to tube and from tube to liquid, as shown in Fig. 10. These films thus act like thin layers of insulating material, reducing heat flow.

The temperature drop depends on the thickness of the film. This in turn depends on the nature of the fluid flow, Fig. 11. As shown by the temperature drops the film is relatively thick for slower, streamlined flow, thin for fast turbulent flow. Presence of scale or other fouling films increases the resistance to heat flow.

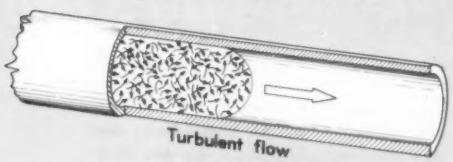
Over-all Coefficients. Each element in the heat path — fluid film, fouling film, metal wall, fouling film and finally fluid film — has its own heat-transfer coefficient U. These must be combined to get an over-all coefficient to substitute in our heat-conduction formula, which then becomes a general heat-transfer formula. Handbooks and standards give typical values of over-all heat-transfer coefficients; these normally include any effects of transfer by radiation. It is often sufficiently accurate to use such coefficients for design. Be sure your conditions closely approximate those for the given coefficient, especially when boiling or condensing are involved.

Turbulent Flow. When a gas or liquid flows through a tube in streamline flow, Fig. 12, *top*, speed is fastest in center, decreases uniformly to zero at tube wall. When a liquid is heated or a gas cooled, it becomes less viscous and annular sections near the wall flow faster. Reverse happens when a liquid is cooled or a gas heated. With fast, turbulent flow there is less speed variation across tube section. Since turbulent flow usually steps up U, it is the basis of the design point in heat exchangers. But turbulent flow means more pressure drop, hence more pumping power.

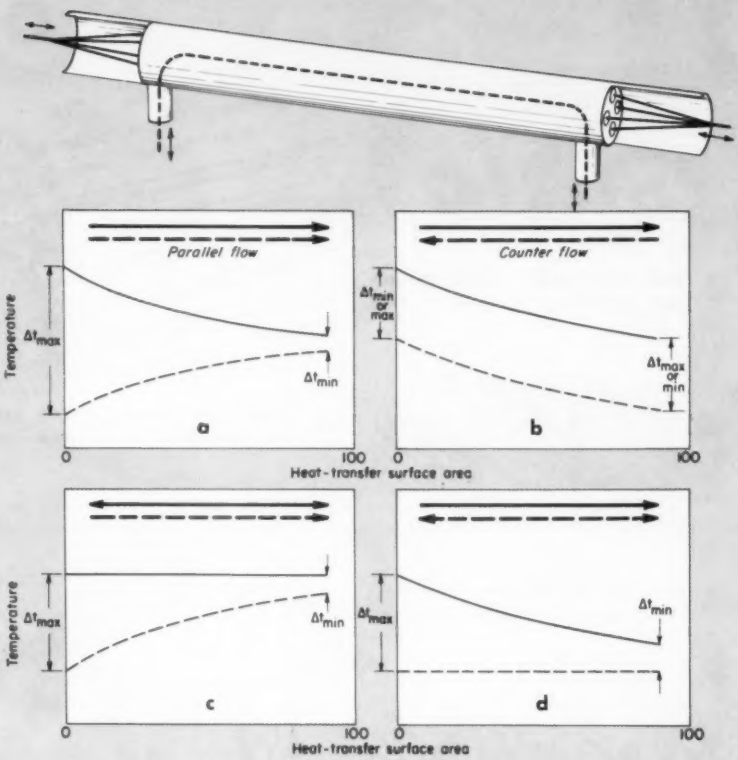
Temperature Variation. In heat exchangers, fluid temperatures change constantly in flow through the unit. Just how they vary depends on relative directions of flow and nature of fluids. In Fig. 13, *a* shows conditions for parallel flow in simple exchanger at top. In *b*, fluids flow in opposite directions, while in *c* warmer fluid is a



With streamline flow, no heat transfer, center core of fluid flows fastest, *top*. Heat transfer changes velocity distribution as shown in next two drawings. Turbulent flow, *below*, shows less speed variation across section



12 **Flow may be streamline, *upper diagrams;* or turbulent, *bottom diagram***



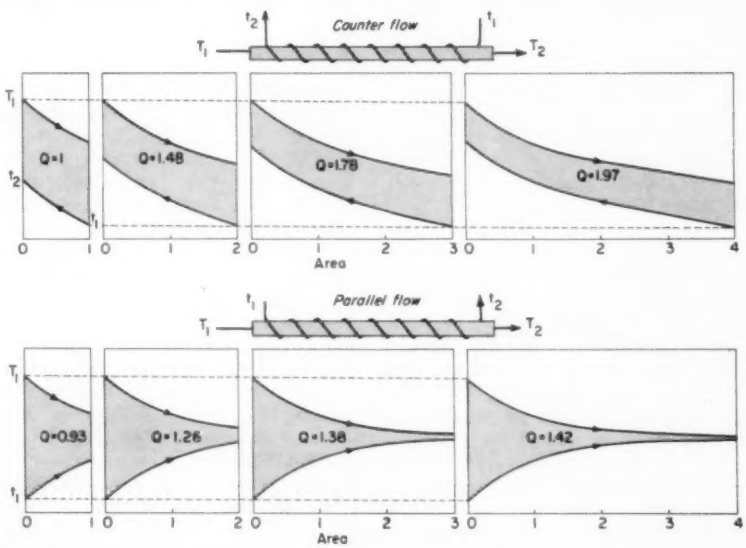
13 **Splitting up fluid streams into several paths increases heat-transfer surface between them for given volume of exchanger. In upper graphs both hot and cold fluid temperatures change in passing through heater. In lower left hot fluid may be a condensing vapor, in lower right cold fluid may be a boiling saturated liquid**

. . . what factors affect it in actual heat-exchanger design practice . . .

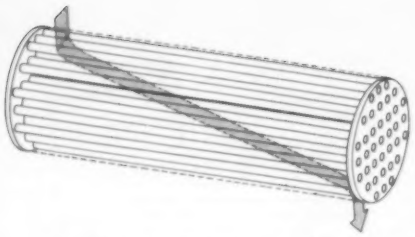
vapor condensing to a liquid at constant pressure. In *d*, colder fluid is a liquid boiling at a constant pressure.

Type of Flow. When two liquids or gases with constant specific heats are exchanging heat, area between their temperature curves is a measure of total heat being transferred. Fig. 14 shows how these vary with amount of transfer area for counterflow and parallel-flow exchangers when fluid inlet temperatures T_1 and t_1 are kept constant. The counterflow arrangement proves superior. If enough surface is provided, leaving cold-fluid temperature can be raised above leaving hot-fluid temperature. This can't be done in parallel flow where the temperatures can only approach each other, regardless of how much surface is used. Counterflow arrangement transfers more heat for given conditions and usually proves most economical to use.

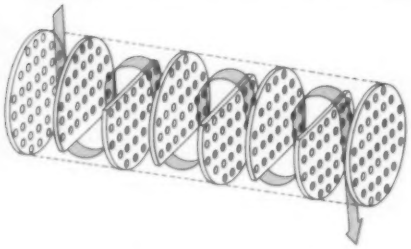
Surface Arrangement. To get maximum amount of surface between two fluids, they must be broken up into thin parallel streams. Familiar shell-and-tube exchanger, Fig. 15, does this



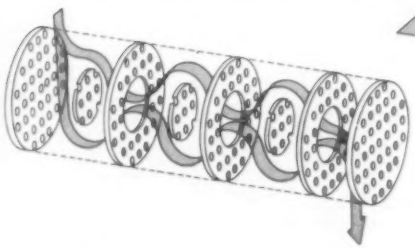
14 **For certain conditions area between temperature curves measures the amount of heat transferred. Increasing heat-transfer area in equal increments does not cause equivalent increase in heat transferred. Adding area to counterflow heaters pays off more than in parallel-flow heaters. Counterflow gives hotter cold fluid**



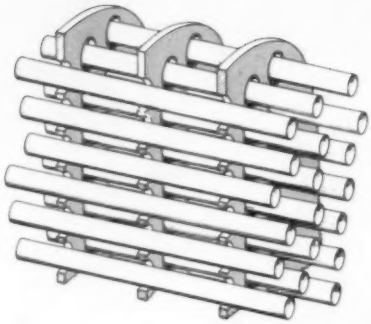
15 Shell fluid tends to take shortest path from inlet to outlet of shell



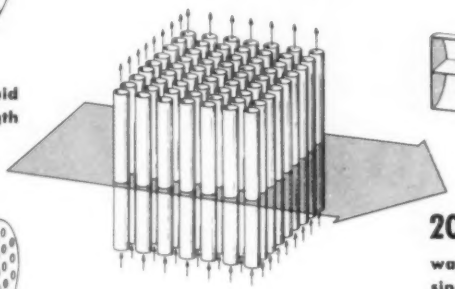
16 Sectional baffling leads shell fluid to contact tube surface along length



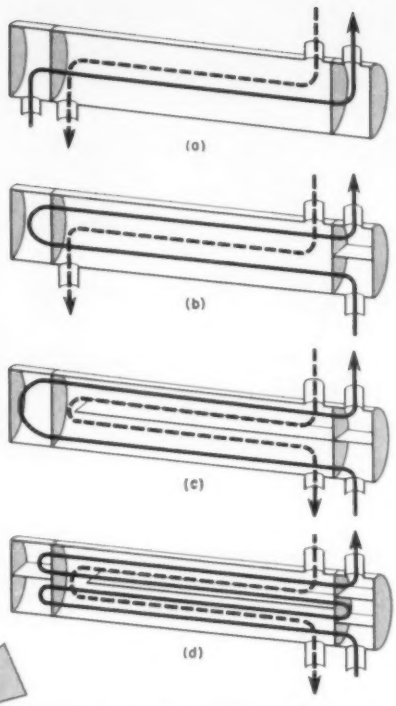
17 Disk-and-doughnut baffling is another method of controlling shell fluid



18 Baffles with annular orifices produce turbulence in the shell fluid



19 Crossflow of the shell fluid alters relation of the temperature changes



20 Paths of fluids through shell-and-tube exchangers can be varied many ways depending on job to be done: (a) single-pass tube and single-pass shell (b) two-pass tube and single-pass shell (c) two-pass tube and two-pass shell (d) four-pass tube and two-pass shell. This last arrangement can be duplicated by putting two heaters like (b) in series for both tube-fluid and shell-fluid flows

. . . and the paths designers take to boost heat-transfer effectiveness

by passing one fluid inside the tubes and the other about the exteriors of the tubes, within a shell. As the ribbon arrow shows, shell fluid will flow by shortest route from inlet, *upper left*, to outlet, *lower right*.

This doesn't make full use of surface, so steps are usually taken to make shell fluid flow over tube exteriors in all parts of the exchanger. This can be done by any of the baffling methods shown in Fig. 16, 17 and 18. The first two involve cross flow of the shell fluid over the tubes, Fig. 19, which affects the variation in temperature and must be accounted for in design.

Shell-and-tube exchangers can be arranged with any number of tube or shell passes, Fig. 20. Arrangement chosen depends on size, cost, nature of fluids and other factors.

Mean Temperature Difference. Although temperatures vary throughout an exchanger, we'd like to have one difference Δt to use in our heat-transfer formula. This must be a representative figure. For a simple exchanger, Fig. 13, this would be the logarithmic mean temperature difference (*lmtd*). This can be calculated, Fig. 21, from largest temperature difference, ΔT, and smallest, Δt.

For more complicated exchanger arrangements, Fig. 20, a correction factor is applied, Fig. 22. The *Standards of the Tubular Exchanger Manufacturers Assn* (*TEMA*) contain a series of graphs for various heater pass layouts.

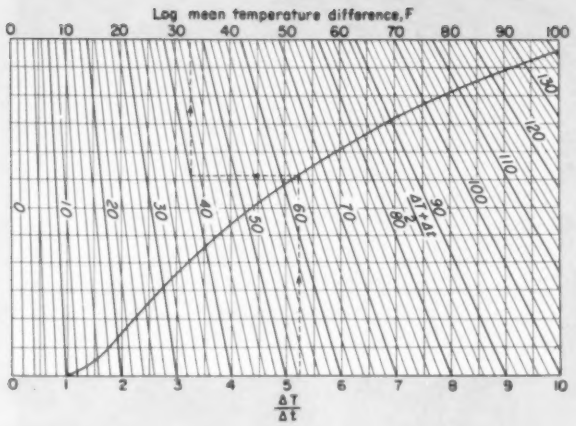
Tube pitch may be triangular or square, Fig. 23; triangular is most used. If exterior tube surfaces require periodic cleaning, spacing must be wide enough to admit a brush or fluid jet.

Boiling and Condensing. As we've seen, changes of state affect heat-transfer rates. In nuclear boiling, Fig. 24, steam bubbles form on minute projections from the heating surface. At atmospheric pressure, water temperature runs 212.7 F and steam 212 F. Increasing buoyancy breaks bubbles away from surface. They absorb heat from liquid and they rise, continuing to grow until they break through the surface. Liquid circulates downward to replace the rising bubbles.

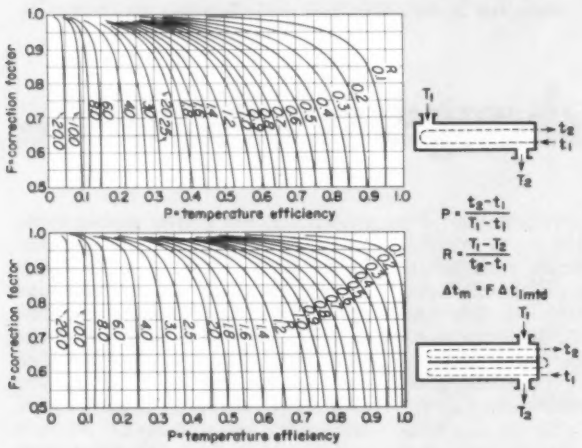
If temperature of heating surface is too high, a film of steam forms between liquid and surface, Fig. 24, *right*. This should be avoided because it reduces heat flow and causes "bumping" in evaporators.

Vapor condensing on a cold surface ordinarily forms a liquid film, Fig. 25, *bottom*. Film reduces heat-transfer rate. In the lab, surface can be treated to produce *dropwise* condensation, which gives better heat transfer. But treatment washes off quickly.

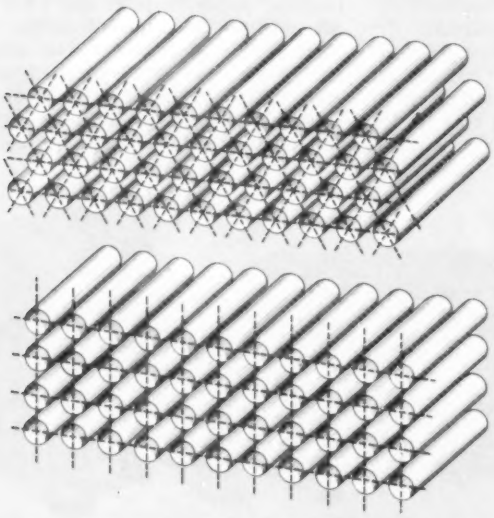
In contact-type heaters and condensers, water is finely divided to mix with steam, Fig. 26. Steam condenses on water droplets, heating them close to boiling temperature. Condensate and heated water leave at shell bottom.



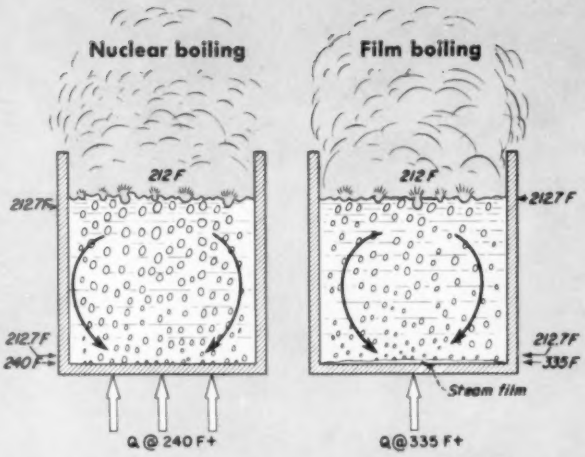
21 Log mean temperature difference can be figured from arithmetic mean and ratio of the temperature differentials



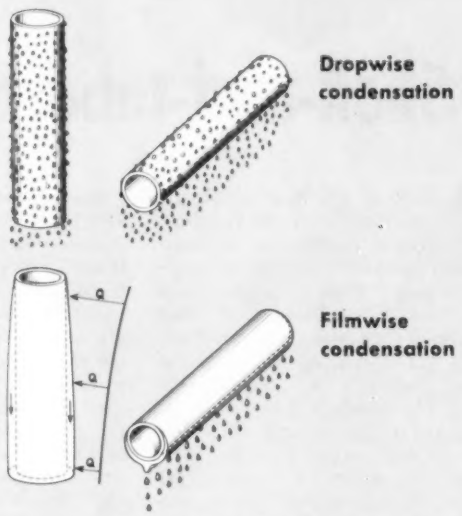
22 When heater flow paths differ from true counterflow a correction factor must be applied to log mean temp diff



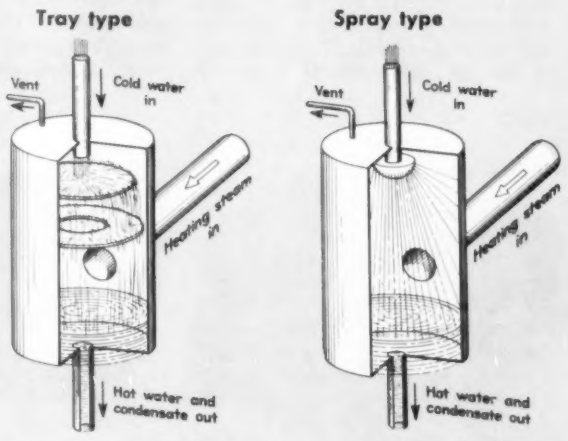
23 Tube pitch may be arranged square or triangular, depends on the space needed for cleaning of the tube exteriors



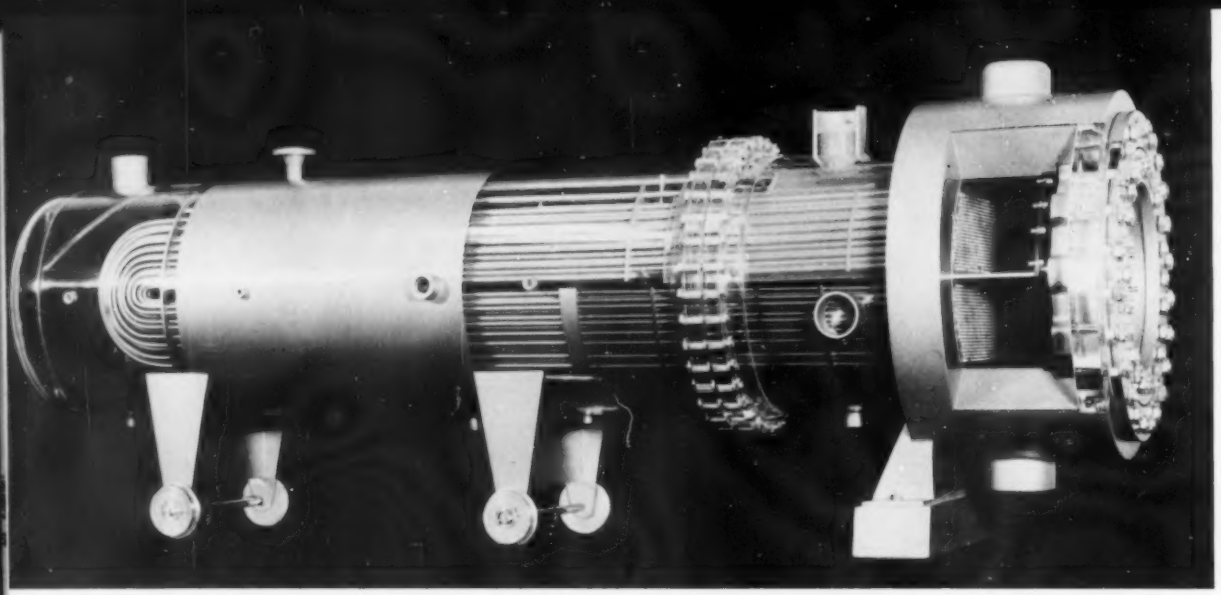
24 Nuclear boiling makes best use of heat transfer surface, too-high metal temperature forms undesired steam film



25 Dropwise condensation can be made to take place for short time under lab conditions, filmwise type is most common



26 Mixing- or contact-type heaters break up cold fluid into small particles to present most surface to absorb vapor



HORIZONTAL FEEDWATER HEATER MODEL shows U-tubes in transparent shell. Water enters through bottom connection of channel, *right*, flows through tubes and leaves at top outlet. Horizontal baffle and sealing plate separates hot, cold water

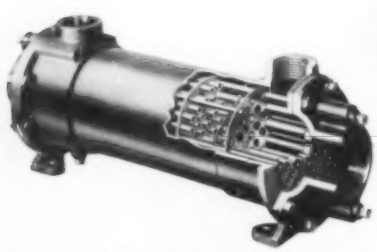
Shell-and-tube exchangers . . . *they are*

Commonest of all heat-exchanger forms is the shell-and-tube construction. Standard models are available for many services; some can be bought "off the shelf." These exchanger "work horses" find a wide variety of power and process applications: (1) feedwater heating (2) lubricating-oil cooling (3) fuel-oil heating (4) service-water heating (5) compressed-air and -gas cooling (6) heat reclaiming from blowdown and other wastes (7) engine cooling (8) transformer-oil cooling (9) refrigeration condensers (10) refrigeration evaporators or chillers, and many others. Chemical and petroleum industries use many forms of exchangers we can't cover here for want of space.

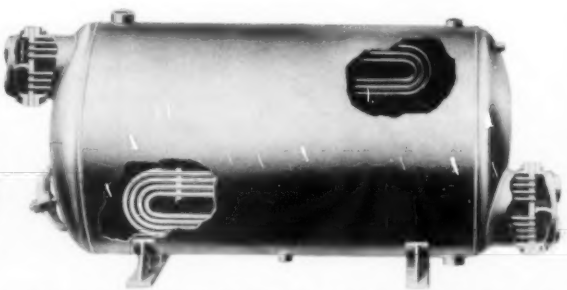
Choosing a Unit. A heat exchanger isn't selected casually. To fit the unit to the job, manufacturer needs the following minimum information: (1) heat load or duty, Btu per hr (2) total quantity flow of fluids entering exchanger, lb per hr (3) specific heat, thermal conductivity, viscosity and specific gravity of fluids, in appropriate units (4) temperatures into and out of exchanger, **F** (5) operating pressures of shell-and-tube fluids, psia (6) allowable pressure drop for each fluid (7) cleanliness of fluids, sediment or contaminants carried (8) available installation space (9) data on corrosive conditions that may affect exchanger materials (10) type of unit wanted (11) horizontal or vertical installation.

Standards. *Tubular Exchanger Manufacturers Assn* (*TEMA*) has set up standards for three classes of shell-and-tube exchangers: (1) class *R* for severe refinery service (2) class *C* for commercial and general process applications (3) class *A* for exchangers using alloys and special materials. In general, standards set up minimums that must be met. These cover all exchanger parts, such as tubes, shells, shell covers, baffles, support plates, tie rods, spacers, floating heads, gaskets, tube sheets, channels, channel covers, nozzle connections, flanges.

Materials. A wide variety of materials is available for exchanger construction; types selected for each part depend on operating conditions, particularly corrosion problems. *TEMA Standards* list the following materials: SHELLS: Pipe of carbon steel or alloy steel. Plate of carbon, carbon-silicon, molybdenum, nickel, chromium, chromium-nickel steels; nickel; monel; aluminum and aluminum alloys; cop-

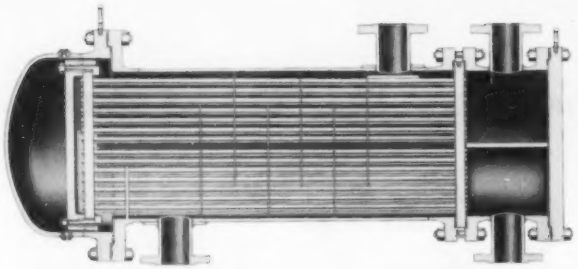


OIL COOLER has fixed tube sheets for economical construction, oil in tubes

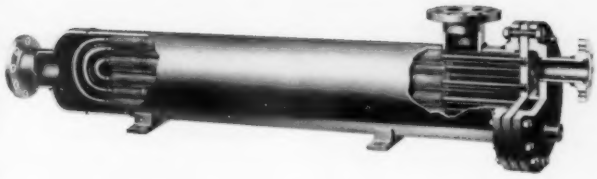


STORAGE-TANK WATER HEATER has two tube bundles, one fed by live steam, other by available exhaust steam

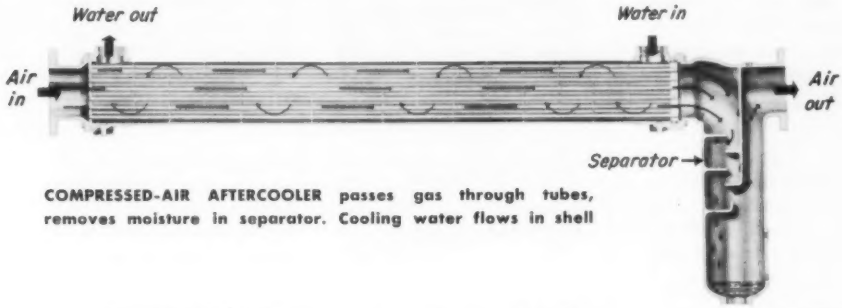
WATER HEATER with coils feeds water-storage tank



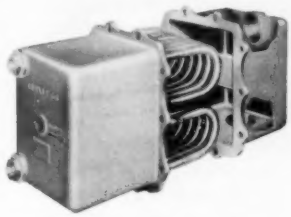
HEAT EXCHANGER WITH FLOATING TUBE SHEET uses sectional baffles to direct the flow of shell fluid across the tube surfaces



LINE OIL HEATER uses finned U-tubes in two passes. Tubes carry steam to heat oil, which flows through shell in one pass



COMPRESSED-AIR AFTERCOOLER passes gas through tubes, removes moisture in separator. Cooling water flows in shell



TANKLESS WATER HEATER uses copper coils with fins to increase heating area

suitable for many jobs

per and copper-silicon alloy; cast iron.

FLANGES: Forged steel, forged alloy steel. Ring flanges of any material used for shell plate.

CHANNELS, CHANNEL COVERS, SHELL COVERS, FLOATING HEADS: Cast steel, cast alloy steel, cast brass, any material used for shells.

TUBE SHEETS: Alloys of copper or iron.

BAFFLES, SUPPORT PLATES: Steel, nonferrous materials.

TUBES: Carbon and carbon-moly steels, alloy steels, copper, copper alloys, nickel, monel, aluminum.

TIE RODS: Same as baffle materials.

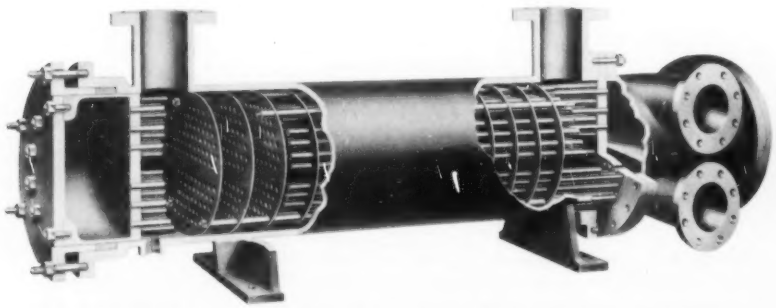
SPACERS: Same as baffles or tubes.

NOZZLES: Forged carbon steel, forged alloy steel, fabricated steel.

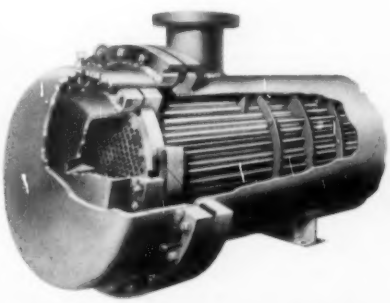
Construction. Main assemblies and parts of exchangers are described on the next two pages. Each must be selected on the basis of the pressure and temperature it has to meet. Design pressures are standardized at 75, 150, 300, 450 and 600 psi. Metal temperatures are limited as follows: Where carbon-steel parts limit strength, −20 to 1000 F; where cast iron limits strength, −20 to 375 F; where naval rolled brass limits strength, 400 F. *TEMA Standards* state that construction shall comply with either *API-ASME* or *ASME Code for Unfired Pressure Vessels.*

Types. Some idea of the diversity of types and services can be gained from the illustrations on these pages. In most exchangers, fluids in both tubes and shell flow continuously during operation. Where both fluids are liquids, or both are gases, there is usually no change of state, simply a temperature change in the fluids. In many of the heating types of exchangers, steam is the energy supply. In giving up its heat, the steam usually condenses and returns to the boiler.

Service-water heaters may be of the continuous-flow type or may provide for storing water in the shell in which it is heated. In the storage type, heating steam may be supplied through a single tube bundle, being admitted in accordance with temperature of water in the tank. Precautions must be taken to prevent boiling stored water. Where intermittent exhaust steam is available, an additional tube bundle may be provided to use this steam in preference to more costly live steam. Whenever exhaust steam can't supply enough heat, live steam is admitted to the live-steam tube bundle.



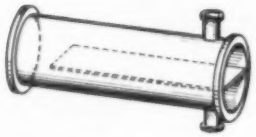
OIL COOLER uses baffles with annular orifices to induce turbulence and good contact of shell fluid and tubes. Packed floating head takes care of tube expansion



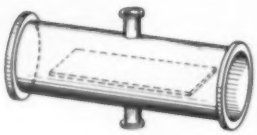
FLOATING TUBE SHEET is designed so tube bundle may be pulled out of shell

Shells . . . *they house tubes and help to direct flow of one fluid*

SINGLE-PASS shell has simplest construction, with inlet and outlet at opposite ends. Connections may enter at any angle needed

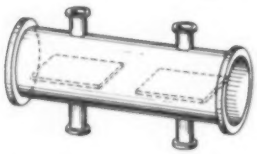


TWO-PASS shell has welded or packed baffle with inlet and outlet on opposite sides of cylinder, may be used for vapor, gas, liquid



DIVIDED SHELL flow has longitudinal baffle for vapor flow distribution along length in both directions, condensate exit on bottom

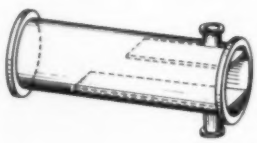
DIVIDED FLOW without baffle depends on two outlets at ends to distribute flow through full length of the shell. Inlet is at top



DOUBLE DIVIDED FLOW has two vapor inlets, two condensate outlets, two longitudinal vapor baffles, is used for very long exchangers

DESUPERHEATING feedwater heater has baffle or shroud at inlet to confine incoming superheated steam around tubes with hottest water

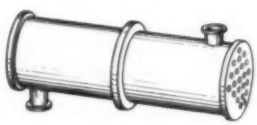
DRAIN-COOLING feedwater heater has baffle or shroud before condensate outlet to confine drains around tubes carrying coolest feedwater



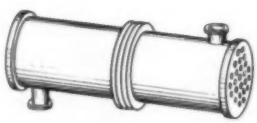
HIGH-PRESSURE heater may have baffles for both desuperheating and drain-cooling sections. Shell may be set vertically if needed

STEAM BELT helps give uniform distribution of vapor to the tube bundle, may reduce impingement erosion of tubes by entering steam

WELDED TUBE SHEETS may be used where shell fluid is clean and will not scale tube exteriors; employed on smaller heat exchangers



SHELL EXPANSION JOINT must be provided on unit with welded tube sheets when temperatures are expected to vary widely

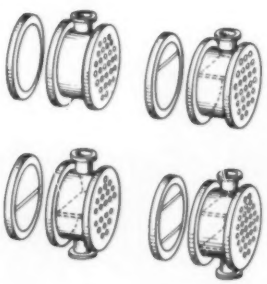


EXPANSION BELLOWS fitted on shell may be used where more flexibility must be provided, but is more subject to corrosive action

Channel layouts . . . *they follow one of several basic forms*

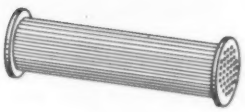
BONNET-TYPE HEADS direct flow of fluid through tube bundle, *left to right:* single-pass, 3-pass, 2-pass, 4-pass heads. Low cost is offset by need to disconnect piping for inspection of tube sheets

CHANNELS AND COVERS do same duty as bonnets, but allow for easy inspection of tube sheets by simply removing the cover. Two-piece construction is more expensive, requires an extra gasket seal

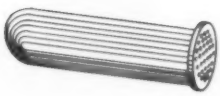


INTEGRAL TUBE-SHEET channels eliminate gasketed joint between head and tube sheet, are used for high-pressure and high-temperature fluids. Partition plates may be welded-in as needed

Tube bundles . . . *layout must allow for expansion, cleaning*

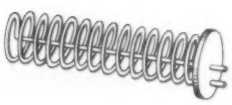


STRAIGHT-TUBE BUNDLE offers the advantage of easy mechanical cleaning of tube interiors, is removed from shell for exterior cleaning

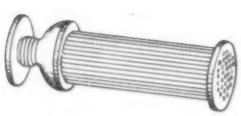


U-TUBE BUNDLE simplifies expansion problem, reduces number of tube-sheet joints. Tubes are difficult to clean mechanically

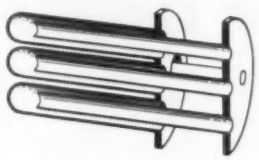
BOWED-TUBE BUNDLE can be solidly bolted to the shell at each end. Bow in tubes takes care of differential expansion in heater



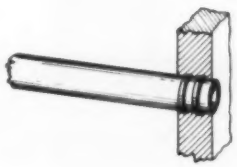
COIL-TYPE HEATERS may be used for very high pressures to eliminate gasketed joints in the h-p circuit. Used in small water heaters



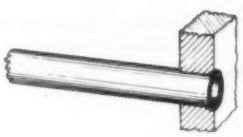
SINGLE-PASS tube bundle may be fitted with an expansion joint internal to the shell to eliminate employing a floating head seal



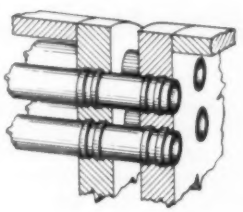
BAYONET-TUBE bundles may be used for some types of tank heaters. Steam enters center tube and returns through annular space to intermediate fluid chamber



ROLLED TUBE JOINT is the most common form of fastening tubes in tube sheets. Cold rolling flows the tube metal into annular grooves cut in the tube-sheet holes



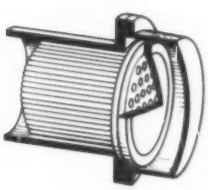
WELDED TUBE JOINT usually remains tighter than a rolled joint where considerable expansion must be handled. Sometimes rolled joints are also welded



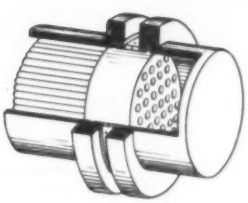
DOUBLE TUBE SHEETS give positive protection against accidental leakage of shell fluid into tube fluid or the reverse. If tubes leak in either tube sheet the leakage shows as a drip between two sheets

Rear-end enclosures . . . *type depends on service needs*

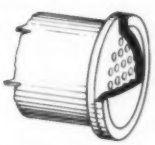
FLAT-PLATE cover may be used on channel formed by the shell end and welded tube sheet. Cover bolts to the shell flange, must be sealed with suitable gasket



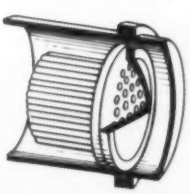
FLOATING HEAD with shell-cover design that reduces clearance between the tube bundle and shell wall. Tube-bundle cover must be removed before bundle can be pulled through the shell



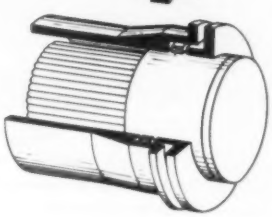
OUTSIDE-PACKED floating head has a dished-plate cover bolting to the shell flange. Two packing rings are separated by a lantern ring, with weep holes. Evidence of leakage from either side shows by drips coming from holes in lantern ring



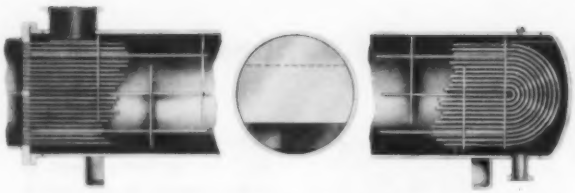
DISHED-PLATE cover may be used on non-removable tube bundle. Cover is bolted on tube-sheet flange, sealed with a gasket or a suitable packing material



FLOATING HEAD for pull-through tube bundle has separate shell cover. Tube sheet and cover move independently of shell. Large annular space exists between tube bundle and shell

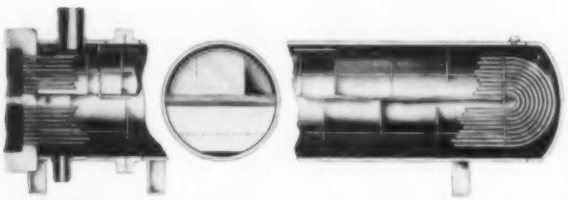


OUTSIDE-PACKED floating head has a flat cover plate on channel with an integral tube sheet. Packed integral gland and gland ring seal the shell and allow the floating head to move independently of the shell with varying fluid temperatures

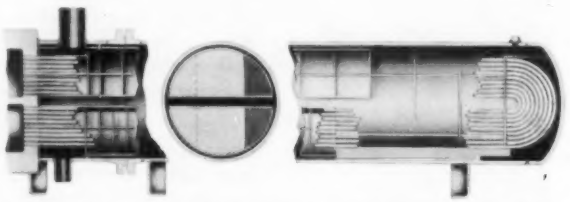


HORIZONTAL HEATER takes in bleed steam at upper left, leads it around baffles for good contact along full tube length. Condensate falls to bottom, drains off at lower right

DRAIN-COOLING HEATER has bottom tubes shielded from main condensing section. Condensate collects at shell bottom, completely covering lower tubes; drains at lower left



DESUPERHEATING HEATER leads superheated steam through enclosed entry section to raise outlet water temperature to maximum possible level. Condensate drains off at lower left



THREE-STEP HEATER desuperheats, condenses, and cools drains of heating steam to achieve maximum possible thermal gain in feedwater-heating cycle where bleed is superheated

Feedwater heaters . . . *these examples of shell-and-tube . . .*

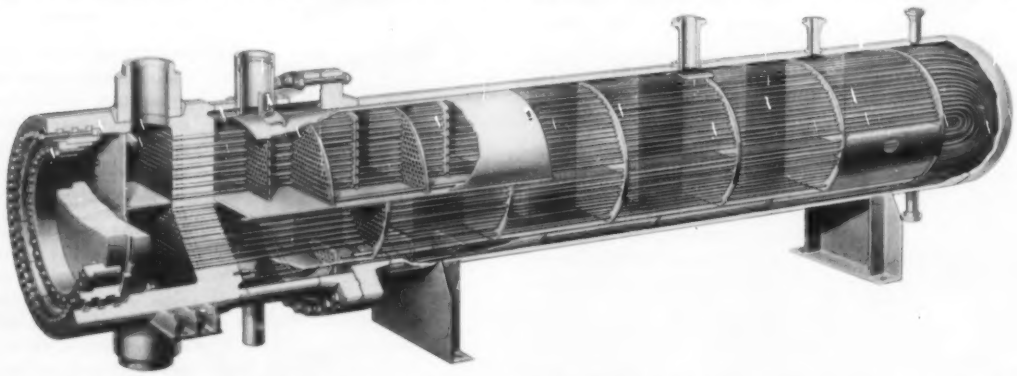
Feedwater heaters normally use steam bled from turbines as the energy supply. Their prime purpose is to raise cycle thermal efficiency by the regenerative-heating principle. Modern cycles may have as many as eight heaters; steam pressure in lowest feedwater heater may be a vacuum and will increase in succeeding heaters to as high as 600 psia, or more. Water pressure in the tubes may run above 3000 psia in high-pressure heaters.

Drain-Cooling Sections. In high-pressure cycles, it often pays to keep energy in the feedwater at as high a temperature level as possible. This is done by using drain-cooling and desuperheating sections in the heaters. In drain cooling, entering feedwater first contacts leaving drains (condensate) before they flash to the lower pressure heater to release their heat at a lower temperature. This lifts feedwater temperature a few degrees it could not realize from the same heat in the lower pressure heater.

Desuperheating Sections. Here, feedwater leaving a heater contacts incoming superheated steam. This again gives a lift to the water temperature that couldn't be obtained from heating at the saturated-steam temperature corresponding to the pressure. Either or both of these special sections may be provided in a heater. Whether they are used or not depends on how cost of more complicated construction compares with the fuel savings realized.

Feed heaters may be installed in either horizontal or vertical positions. In vertical heaters, the channel may be in the upper or lower position. For each of the possible positions, special consideration must be given to layout of the heater controls.

Specifications. Except for drain-cooling and desuperheating sections, feedwater heaters do not differ greatly in principles from the usual shell-and-tube exchangers. The *Bleeder Heater Manufacturers Assn, Inc,* publishes *Standards* for mechanical and thermal design and construction of these water heaters. The *Standards* specify maxi-



HIGH-PRESSURE FEEDWATER HEATER with integral desuperheating and drain-cooling sections, takes in bleed steam at 931 F. Double-tube steam inlet minimizes any distortion and leakage at flanges. Tube water pressure runs about 2000 psig

VERTICAL HEATER has vents to aid in steam distribution, drains leave shell at bottom

DRAINS FLOW up through cooling section, leave through center channel at heater top

SECTION at inlet cools superheated steam, condensate drains through shell bottom

THREE-STEP HEATER desuperheats inlet steam and cools condensate leaving at the top

...design use bleed or exhaust steam to boost the cycle efficiency

mum metal temperatures for tube materials as follows:

Arsenical copper	400 F
Admiralty metal (all types)	450 F
90-10 copper-nickel	600 F
80-20 copper-nickel	700 F
70-30 copper-nickel	700 F
30-70 copper-nickel (monel)	800 F*
30-70 copper-nickel (monel)	900 F**

*stress relieved **annealed

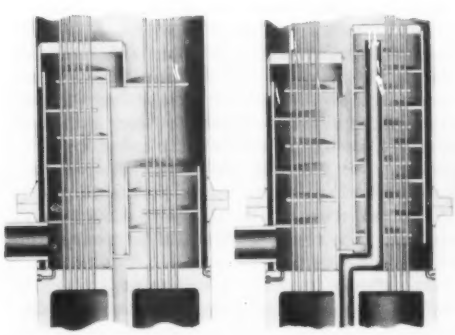
Baffles. Triangular tube pitches are recommended for feedwater heaters. To avoid exterior tube erosion at steam and flashed-condensate inlets, tubes should be covered by impingement baffles opposite the inlets. These turn aside the steam so it enters the tube bundle around its periphery.

For effective heater performance, baffles must fit snugly around tubes and to the shell interior. Any openings allow the shell fluid (steam or condensate) to short-circuit around passes and thus fail to do an effective heat-transfer job. On the other hand, these joints must allow differential movement between tubes and shell, caused by temperature changes. Also, it must be possible to separate tube bundle and shell for inspection and repair.

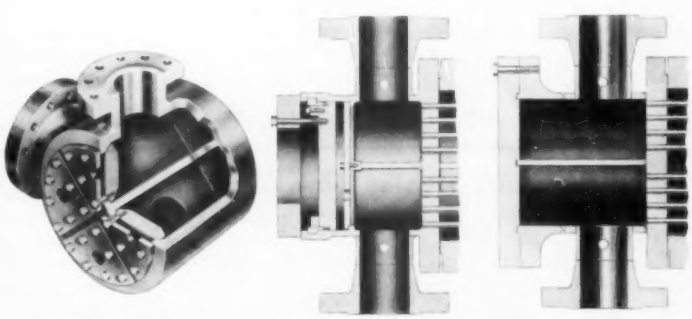
Joints. Note that some of the shells shown on these pages have a flanged joint to the right or below the steam inlet. This allows removing the shell without breaking heavy connections.

Protection. All steam and water lines to a feed heater (as well as other types of exchangers) should be valved and bypassed to allow bringing the unit in and out of service without shutting down the rest of the cycle. On the steam line, a check valve as well as a gate valve is needed to keep water flooding the heater from backing up into the turbine.

Relief Valves. Both tube side and shell side of a heater must be protected by relief valves against accidental overpressures. Valving must take account of high-pressure tubes bursting in a lower pressure shell. The protection scheme of a heater is normally the responsibility of the buyer, but makers stand ready to advise on the layout.

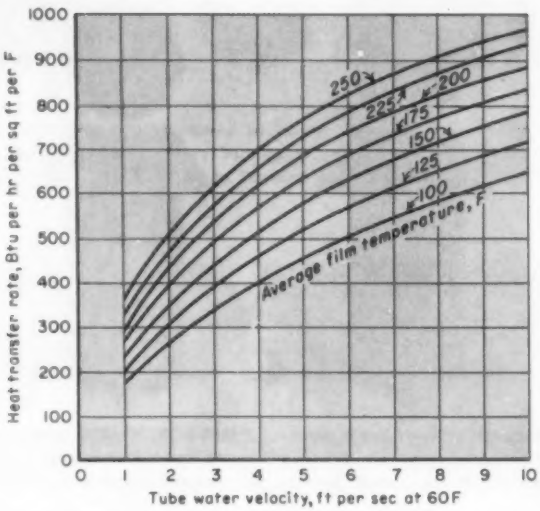


INVERTED CHANNELS on vertical heaters can use desuperheating, drain-cooling sections. Latter may be counterflow, *left;* parallel flow, *right*



HEATER CHANNEL design depends on feedwater pressure and ease of handling during maintenance work. High-pressure head, *left,* has four compartments to reduce wall thickness; medium-pressure, *center;* l-p, *right*

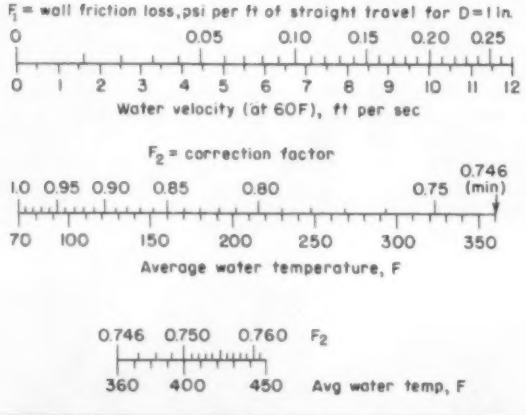
Standard factors . . . *they're basis for sizing heaters*



I–Multipliers For Base Heat-Transfer Rates

(For tube OD ⅝ to 1 in. incl)

	TUBE MATERIAL					
BWG	Ars-cu	Adm	90/10 Cu-ni	80/20 Cu-ni	70/30 Cu-ni	Monel
18	1.00	1.00	0.97	0.95	0.92	0.89
17	1.00	1.00	0.94	0.91	0.87	0.85
16	1.00	1.00	0.91	0.88	0.84	0.82
15	1.00	0.99	0.89	0.86	0.82	0.79
14	1.00	0.96	0.85	0.82	0.77	0.75
13	0.98	0.93	0.81	0.78	0.73	0.70
12	0.95	0.90	0.77	0.73	0.68	0.65
11	0.92	0.87	0.74	0.70	0.65	0.62
10	0.89	0.83	0.69	0.66	0.60	0.58
9	0.85	0.80	0.65	0.62	0.56	0.54


F1 = wall friction loss, psi per ft of straight travel for D=1 in.
0 0.05 0.10 0.15 0.20 0.25
0 1 2 3 4 5 6 7 8 9 10 11 12
Water velocity (at 60F), ft per sec
F2 = correction factor
1.0 0.95 0.90 0.85 0.80 0.75 0.746 (min)
70 100 150 200 250 300 350
Average water temperature, F
0.746 0.750 0.760 F2
360 400 450 Avg water temp, F

II–Feedwater-Heater Tube Constants

Tube	⅝-in. OD		¾-in. OD		⅞-in. OD	
BWG	D	$D^{1.24}$	D	$D^{1.24}$	D	$D^{1.24}$
18	0.527	0.452	0.652	0.589	0.777	0.731
17	0.509	0.433	0.634	0.567	0.759	0.710
16	0.495	0.418	0.620	0.554	0.745	0.695
15	0.481	0.404	0.606	0.538	0.731	0.678
14	0.458	0.380	0.584	0.514	0.709	0.652
13	—	—	0.560	0.488	0.685	0.625
12	—	—	0.532	0.457	0.657	0.594
11	—	—	—	—	0.635	0.570
10	—	—	—	—	0.607	0.538

Basis for designing feedwater heaters is outlined in the *Standards of Bleeder Heater Manufacturers Assn, Inc.* Data abstracted from these standards are given in the left-hand column. The graph gives the heat-transfer rates to be used for given tube water velocities and average film temperatures. The latter is calculated as:

$$F_{ft} = t_s - (0.8 \times t_{lmtd})$$

where F_{ft} = average film temperature, F
t_s = saturation temperature of steam, F
t_{lmtd} = logarithmic mean temperature difference, F

Heat-transfer rates in excess of those for 250-F film temperature should not be used. These rates apply when steam is supplied from: turbine exhaust, turbine bleed point, evaporator vapor outlet, boiler. Water flowing through the tubes should be feedwater as would be found normally in a closed cycle.

The *Standards* specify that condensing zones in heaters and simple condensing heaters should not be designed for a closer approach to saturated steam temperature than 2 F. The heat-transfer rates of the graph are subject to several corrections. If either steam or water differs from the standard specified above, multiply the rates by 0.85. If both differ, multiply by 0.72.

Finally, refer to Table I and find a multiplier corresponding to the tube thickness and tube material, to use on the rate from the graph. The multipliers grow smaller with decreasing tube size and decreasing copper content. Tube material must be chosen to cope with the corrosion conditions that will be encountered.

Subcooling zones in heaters shouldn't be designed for a terminal difference of less than 10 F between the shell drain and the tube inlet.

Pressure drop of feedwater flowing through seamless drawn tubing in the heaters is figured as:

$$\Delta p = F_1 F_2 (L + 5.5D) N / D^{1.24}$$

where Δp = pressure drop, psi
F_1 = correction factor from scale, *left column*
F_2 = correction factor from scale, *left column*
L = total linear feet of tubing divided by number of tube holes in one tube sheet
D = tube ID, in., from Table II
N = number of passes

In figuring F_2 the average water temperature is equal to $t_s - t_{lmtd}$.

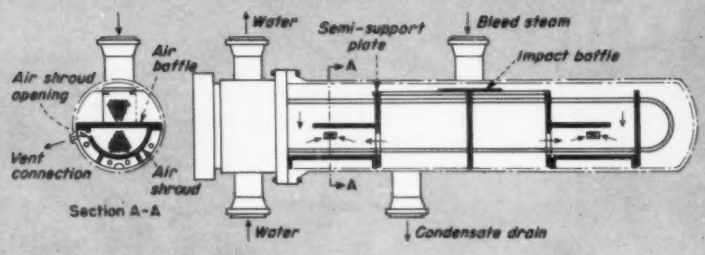
Pressure drop through heaters is important in determining condensate- and feed-pump pressures needed.

Heat exchangers for general process and refinery work are covered in the *Standards of Tubular Exchangers Manufacturers Association.* Because of the wide variety of fluids covered, determinations of heat-transfer rates are more detailed than those for feedwater heaters.

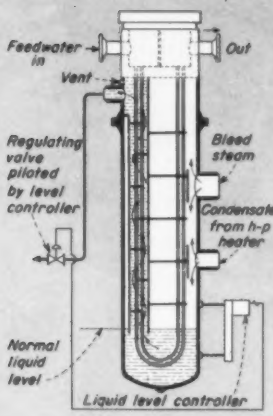
The method involves selecting film coefficients on each side of the tubing, fouling resistances on each side, resistance of the tube wall corrected for thickness, and ratio of internal to external tube surfaces. These factors vary with tube material and the fluids used.

Friction factors based on Reynolds numbers, which in turn involve fluid viscosity and density, must be determined in advance of calculating the pressure drop through the heater tubes.

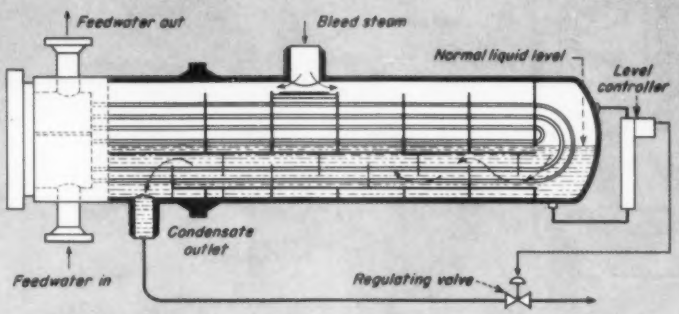
Thermal conductivities and specific heats of the gases, vapors and liquids must also be considered.



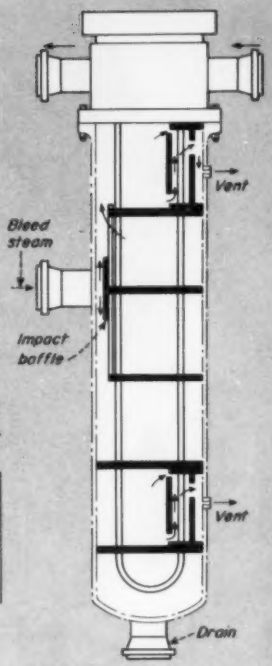
SHROUDING ENTRANCE TO AIR VENTS forces moisture-laden air to pass first over colder tubing to condense out as much steam as possible so only saturated air and not live steam leaves the feedwater heater



LEVEL must be held closely to prevent steam blow-through



AUTOMATIC LEVEL CONTROL helps to keep drain-cooling section submerged in condensate and prevent flooding of steam-condensing section. Controller must be properly tapped into shell to avoid effects of flow



AIR VENTS aid steam distribution in heater's shell

Venting and draining . . . *essential to good operation*

Successful performance of feedwater heaters depends on proper venting (POWER, April 1952, pp 92-93, 208) and correct draining (Nov, 1952, pp 75-77). These apparently minor considerations make or break operation.

As steam condenses in either a vertical or horizontal heater, the condensate falls to the shell bottom and forms an effective seal against steam blowing through. This seal also prevents noncondensable gases from leaving the heater. Any accumulation of noncondensables can "air blanket" a heater, reducing its effectiveness or putting it out of action. This becomes especially important for low-pressure heaters operating below atmospheric.

Vents are the answer — at proper spots in the shell, they remove any gases that might accumulate. Vents should be placed in each end of the steam space, as shown in the sections, *above*. In addition to removing gases, the vents help to distribute the steam more uniformly throughout the shell and make better use of heat-transfer surface.

Baffles in the shell at entrances to the vent holes make the gas-laden steam flow first over the coldest tube pass, to condense out as much of the steam as possible. High-pressure heaters can be vented to the deaerating-heater vent condenser and the low-pressure heaters to the main-condenser air-cooling section.

Vent piping systems need regulating valves to set the optimum gas-withdrawal rate. This is the smallest rate that has no measurable effect on temperature rise of the feedwater passing through the heater. Excessive venting wastes high-grade uncondensed steam.

Vent piping should be inspected regularly. Moisture-laden gases leaving the heater can be highly corrosive and form rust and scale in the vent lines. Any sudden drop in heater duty will most likely be caused by reduced venting caused by blockage in the venting system.

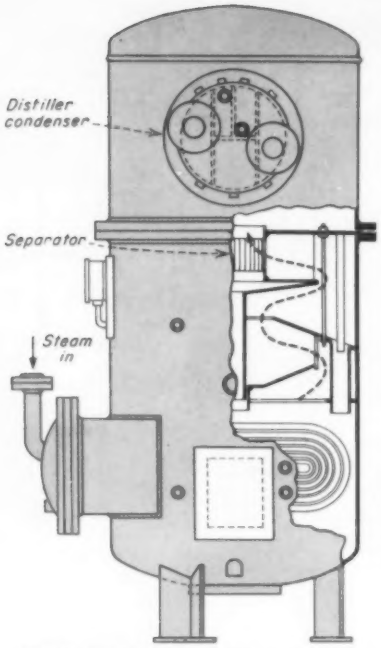
Preferably, each vent opening should be connected by a separate line to the receiver, with as few bends and as short a route as possible. Tying together both vent openings at a heater may reduce venting capacity and makes it difficult to balance flows through them.

Positive control of heater drainage insures proper operation. If the condensate rises too high in either vertical or horizontal heaters, active condensing surface is put out of service. If condensate drops too low in a vertical heater with a subcooling zone, live steam discharges through the drain. If this happens in a similar horizontal heater, the amount of subcooling drops off.

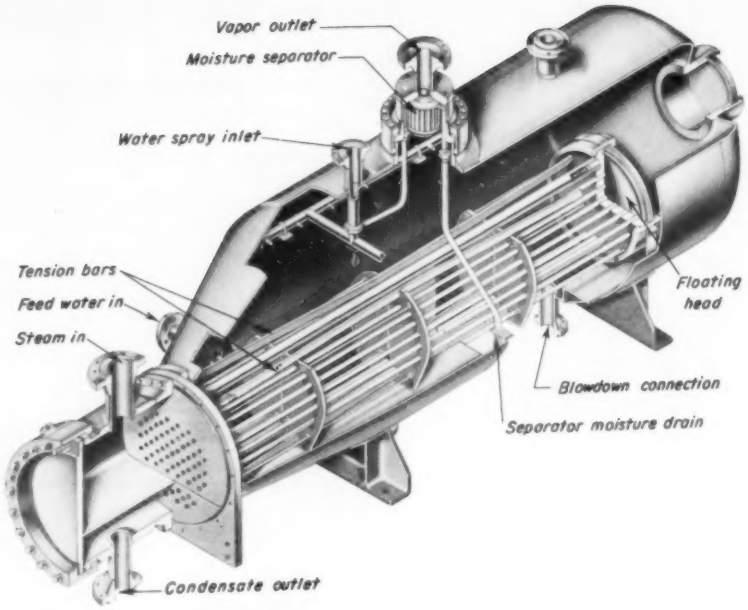
Two types of liquid-level controllers are used for drainage control: (1) direct-acting ball float, and (2) float-operated pilot valve. The direct-acting controller links mechanically to the drain-line regulating valve. The second type has the pilot valve controlling a regulating medium (pressurized oil or air) to close and open the regulating valve. The first does a fine job where condensate level can vary to some extent, as in an external hotwell. The second type should be used where a critical water level must be maintained.

Make sure that the level controller connects to the shell where water-level indications are correct. Never place one of the taps in or near the drain line itself. Water velocity in the drain line reduces the pressure at the tap.

Gage glasses on both float chamber and heater permit making frequent checks for proper operation. Such glasses must have isolating stopcocks in case of breakage.



STEAM BUNDLE evaporates water to vapor, which condenses in exchanger above



WATER LEVEL maintained just above steam tube bundle gives large steam release surface. Tension bars make the tubes bow when hot by restraining their expansion

Evaporators... *they deliver purified water*

In power plants, evaporators produce makeup for boiler feedwater from raw water high in solids. In some cases, they have been used as *steam transformers*, in which high-pressure exhaust or extraction steam from turbines turns raw water to steam for processing. This scheme isolates the closed boiler-turbine cycle from the process water-steam cycle. On shipboard, and in areas where fresh water is scarce, evaporators distill potable water from sea water (*above, left*).

Evaporators consist of two circuits: (1) "heating" steam condensing to water for return to the boiler, and (2) raw water vaporizing and leaving behind unwanted salts and solids. Input to an evaporator comprises steam to the tube bundle and raw water to the shell. Output includes the condensate of the heating steam from the tube bundle, vapor from the shell, and concentrated raw water (blowdown), also from the shell. Vapor produced is condensed to distilled water, often in a separate heat exchanger.

Tube bundle, completely submerged in raw water, supplies heat for boiling. Shell pressure may vary from a fairly high vacuum to a pressure of 200 psig, or more. Steam feed to the tube bundle must be at a higher pressure to supply temperature differential needed for effective heat transfer. Normally, shell water level is held at the horizontal center line to realize maximum water surface for steam release. This helps to keep down moisture carryover in the vapor.

Moisture particles in the vapor carry solids with them, so steps must be taken for removal. Mechanical separators or eliminators, just before the vapor outlet in most designs, force vapor to turn several sharp corners. Centrifugal force throws the moisture to the separator walls. Collected moisture drains back to the raw water in the evaporator shell.

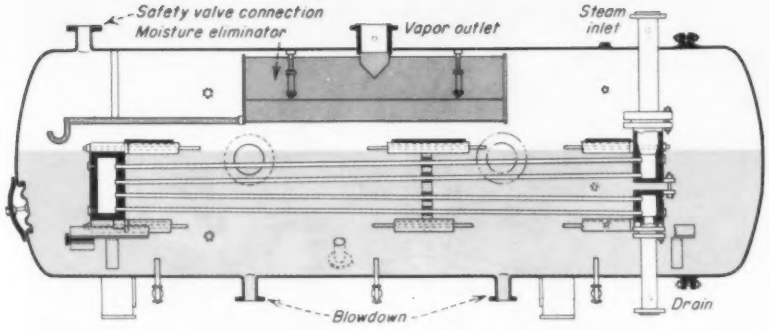
Another method of carryover elimination is the bubble tray (*see facing page*). Vapor from the shell enters the under side of the bubble caps. To pass on, vapor must bubble through clean condensate before escaping to the dome above. The clean condensate must be supplied from the plant cycle. Contaminated condensate overflows through a sealing U tube to join the raw water in the shell.

Blowdown. Continuous evaporation of raw water leaves behind an increasing concentration of salts in the shell water. These must be blown down at intervals, or continuously.

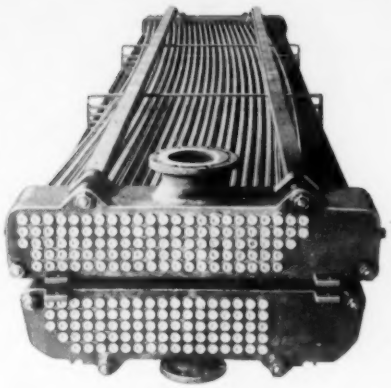
Scale Cracking. In high-temperature evaporators, some solids form a hard scale on tube exteriors. Since scale impedes heat transfer, it must be removed periodically. This is done by draining the shell and spraying the tube bundle with cold water, while tubes are still hot. Thermal shock usually cracks scale and spray washes it off for removal through shell bottom.

Some designs aid scale cracking by bowing the tubes (*upper right above, and facing page*). By using a restraining tension bar, tubes are forced to take a bowed shape when they expand in operation. When shell is refilled with cold water, tubes straighten quickly, helping to crack off the scale.

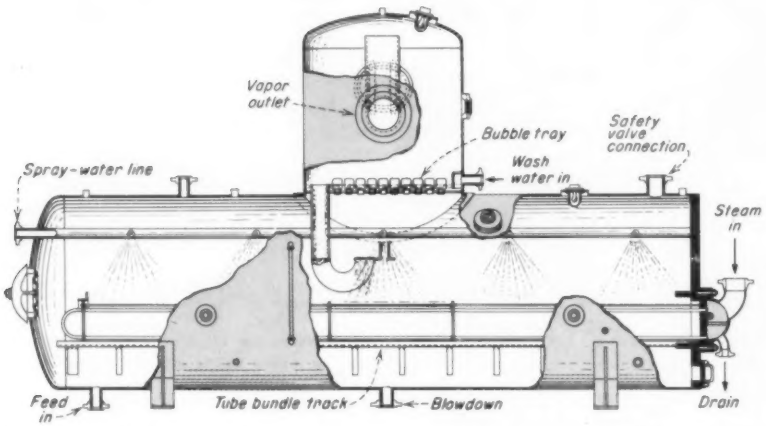
Compression-distillation systems (*on facing page*) take in sea water, pass it through a preheater to be warmed by distilled water and concentrated brine from the evaporator. In the latter, sea water is boiled by condensing superheated and compressed vapor. Vapor from the sea water flows through the separator and into the compressor, then back to the evaporator to vaporize incoming sea water. Preheater is usually a double-tube heat exchanger.



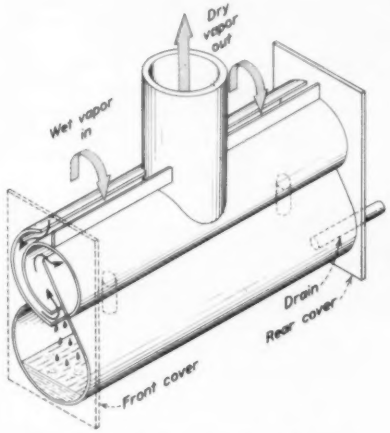
TUBE-BUNDLE INLET AND OUTLET are completely enclosed in evaporator shell. Separator at vapor outlet removes moisture and drains it back to shell above water



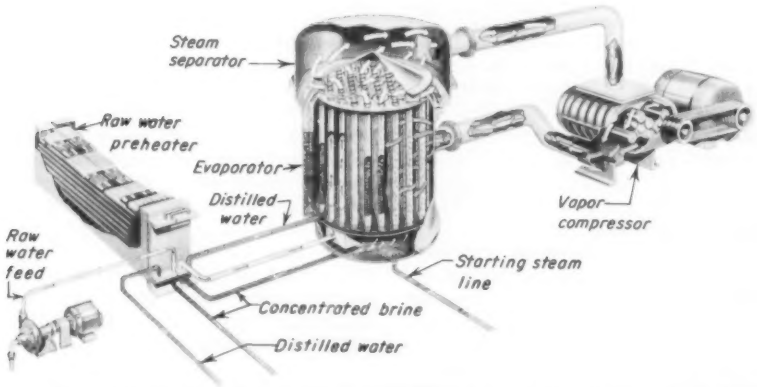
TUBES BOWED in cold position, bow more when heated; this cracks off scale



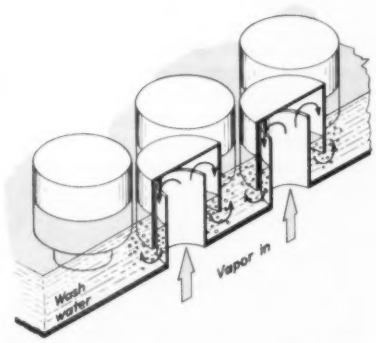
VAPOR WASHED by condensate on bubble tray removes carryover. Condensate, carrying contamination, continuously drains to evaporator shell through U-tube seal



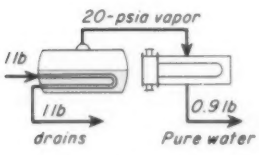
SEPARATOR makes vapor flow through several sharp turns, throws out moisture



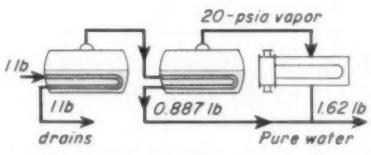
COMPRESSION DISTILLATION uses: evaporator-condenser to produce vapor from raw water, compressor to heat vapor which condenses in main unit as pure water



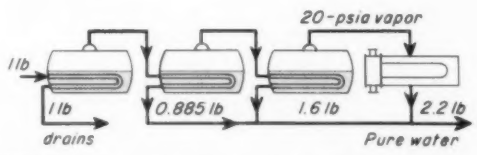
BUBBLE TRAY forces vapor from below to bubble through the clean condensate



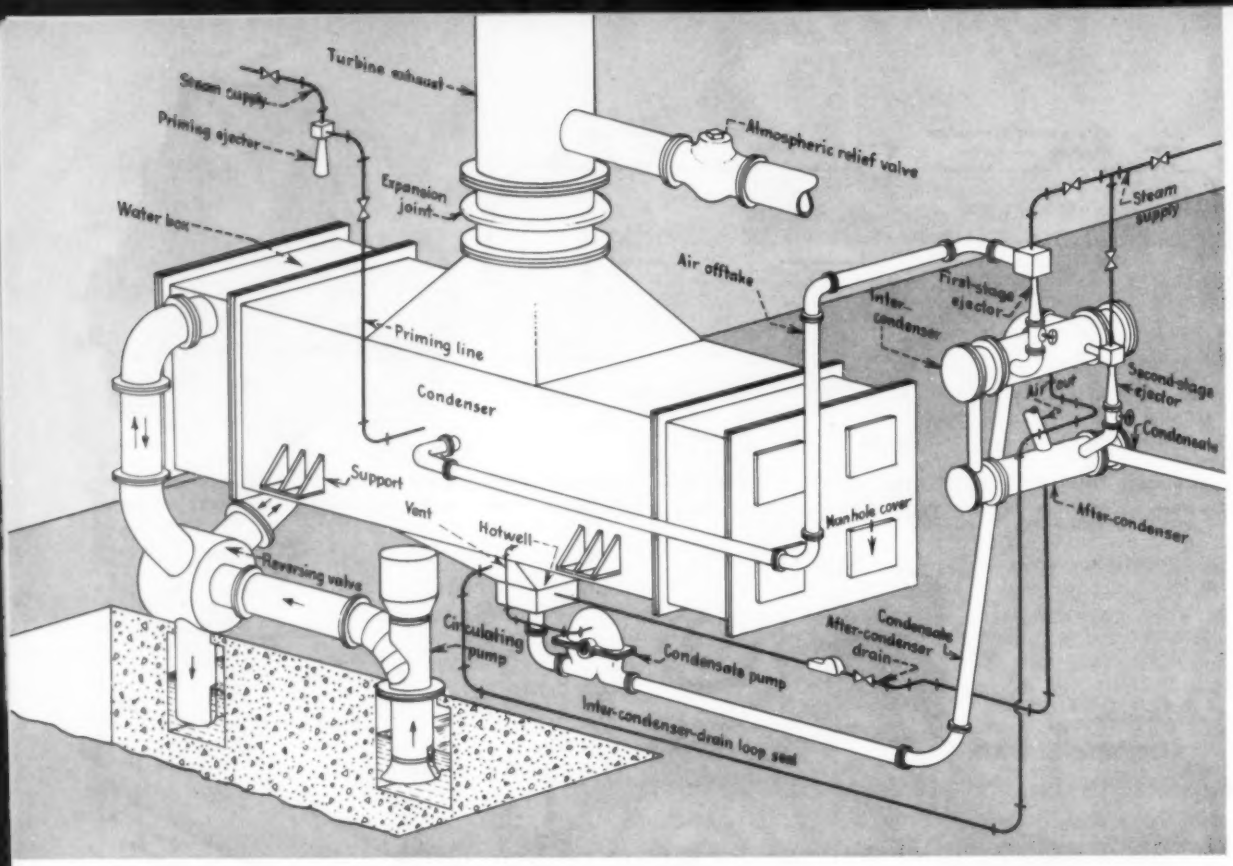
SINGLE-EFFECT evaporation uses but one evaporator



DOUBLE-EFFECT evaporation uses vapor from first unit to heat second unit



TRIPLE-EFFECT evaporation cascades heat through three units, produces most vapor from 1 lb steam



1 **Two-pass condenser with principal auxiliaries: Reversing valve provides for backwashing. Pedestals (not shown) give solid support; expansion is taken up in joint in turbine exhaust pipe. Manhole plates on water boxes are usually hinged**

Surface condensers... *the major features*

Steam surface condensers do two big jobs: First, and usually most important, they reduce backpressure on turbines so maximum heat energy can be extracted from steam. Power produced in expanding steam from atmospheric pressure to 29 in. Hg vacuum roughly equals that produced in expanding from 200 psig, 600 F to atmospheric.

Second, surface condensers recover low-oxygen-content full-temperature condensate for boiler feed. Where feedwater is expensive, this may be as valuable as backpressure reduction.

Surface condensers are basically vacuum-tight shell-and-tube heat exchangers with cooling water flowing through tubes and prime-mover exhaust steam surrounding the tubes. Cold tube surfaces condense steam; resulting large reduction in volume produces a vacuum. Cooling water carries away latent heat of condensation.

One way or another, exhaust steam is used to heat and deaerate the condensate. This is finally collected in a hotwell and introduced into the feedwater system, thus fulfilling the surface condenser's second major function.

Air Removal. To maintain vacuum, the condenser must get rid of air that always works its way into the shell in small quantities. This air, if allowed to remain, would blanket tube surfaces, reduce heat transfer and eventually destroy the vacuum. One of several forms of air pumps removes it.

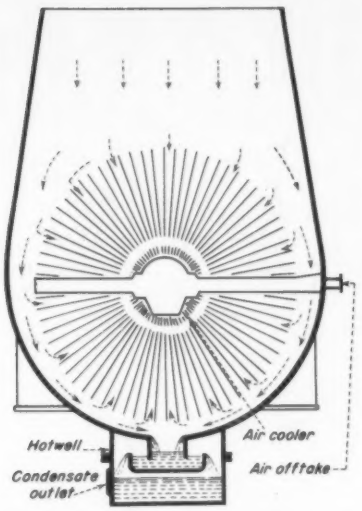
Other major condenser auxiliaries are pumps for circulating cooling water and removing condensate from the hotwell. External parts of a surface condenser and the auxiliaries needed to make it work are shown above. Tube sheets and support plates, along with other features of modern condenser practice, are shown on facing page.

Tube Layout. Today's designers seek to make all tube surface take an active part in carrying away latent heat of condensing steam. Thus, modern condensers use an open arrangement for tubes first hit by high-velocity exhaust steam from the prime mover. As steam penetrates deeper in the tube bank, and condensation reduces its volume, spacing gets closer. Tightest tube arrangement is usually found in the air-cooler section.

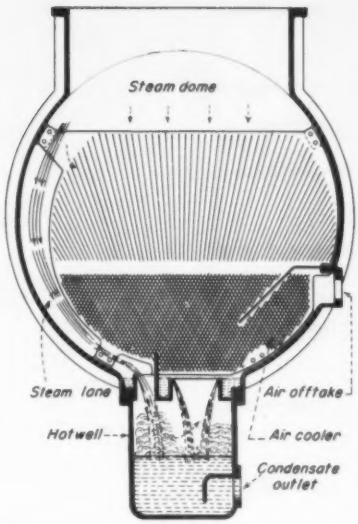
Reducing flow area as steam volume shrinks keeps velocity high enough to sweep air to the cooler, where it is removed by the air pump. Resulting fan-shaped arrangement makes steam scrub all surfaces, puts air in right spot for removal. Last portion of steam comes in contact with coldest tubes. Such schemes for making heat-transfer surfaces work at top capacity reduce surface needs of modern units.

Free steam flow along condenser's length is made possible by leaving openings in tube support plates where there are no tubes (see illustrations). Ample space at top of condenser insures good initial distribution. Area near cooling-water inlet has greatest condensing capacity, hence gets more steam. In addition, designers often put air offtakes and vacuum equipment there, to induce even more steam flow and effectively handle resulting greater load of noncondensables.

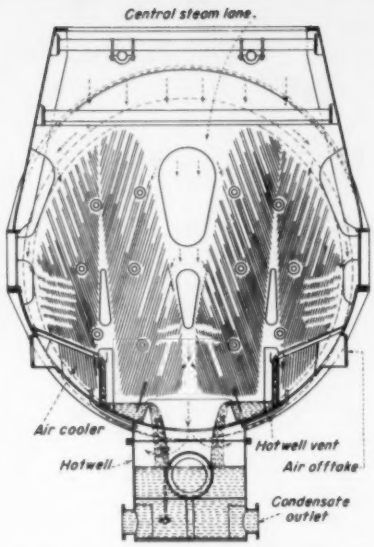
Heating, Deaerating. Steam coming directly from prime-mover exhaust



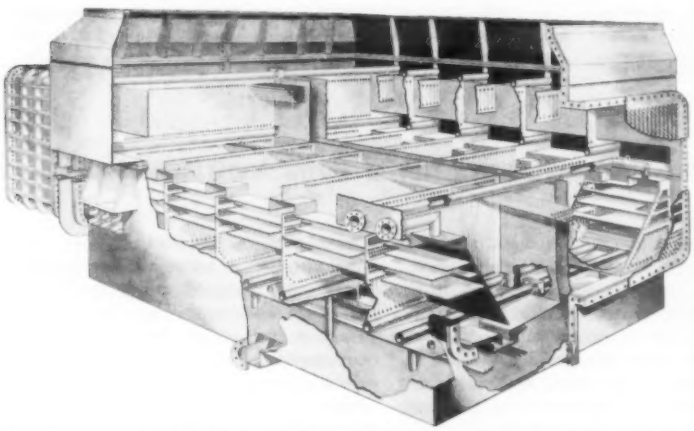
2 Deaeration and heating take place as steam rising from bottom comes in contact with falling condensate. Air is removed at the center of condenser



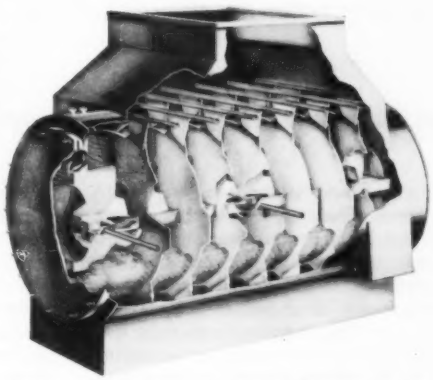
3 Annular space at left in this nondivided-water-box condenser provides passage for part of steam to deaerate and heat condensate flowing to hotwell



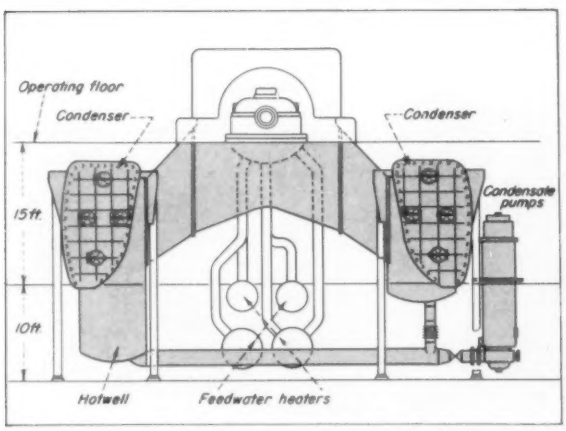
4 A venturi-shaped center lane allows heating and deaerating steam to pass. Note open arrangement of tubes to give steam access to all portions of surface



5 Note air-cooling sections with takeoff pipes, spring mounting, shell expansion joint, strengthening struts across condenser, slight bow in tubes for drainage, center steam lane and heating-deaerating arrangement

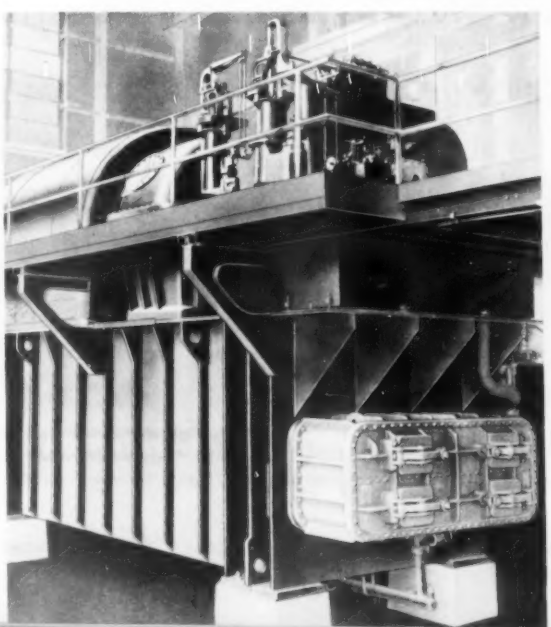


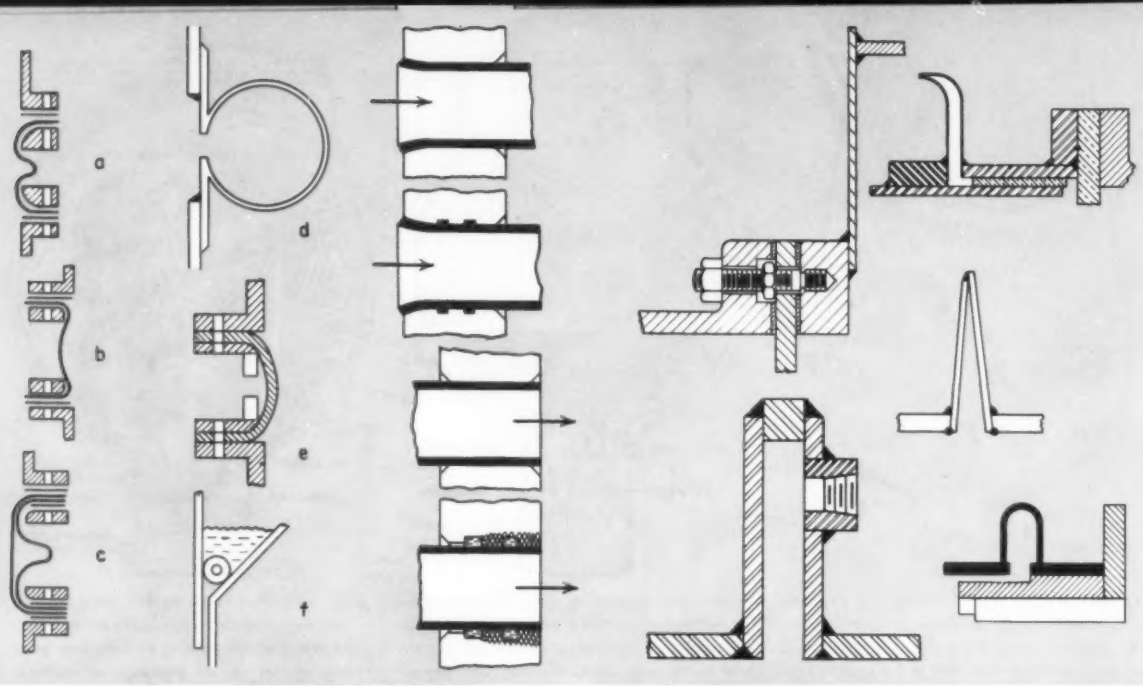
6 Space in tube-support plates, between tubes and shell, allows free distribution of steam throughout condenser. Air takeoff is at shell top



7 Split setup for side-exhaust turbine. Steam enters horizontally, flows up to air cooler; condensate falls to well

8 Foundation-support condenser carries all of turbine weight





9 Typical turbine-exhaust expansion joints: *(a, b)* copper or stainless steel, *(c)* copper with stainless-steel protection, *(d)* stainless steel, *(e)* rubber, *(f)* slide joint with rubber hose and condensate seal. Center drawings show common tube-seating arrangements; fiber-and-metallic ring packing at outlet allows for expansion. Shell expansion joints at right

After a look at condenser basic elements, and their construction . . .

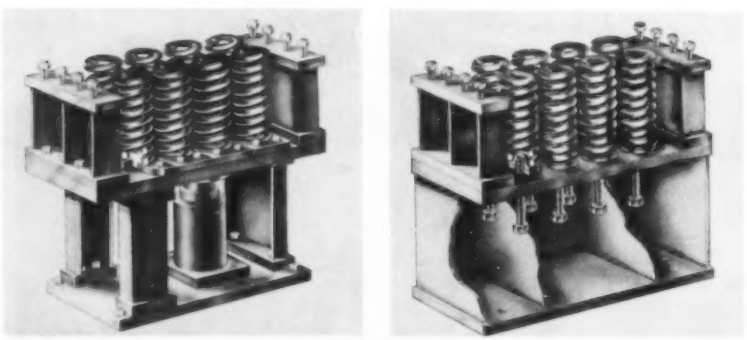
scrubs condensate on its way to the hotwell. This deaerates and heats condensate for introduction into the feedwater system, Fig. 2,3 and 4. Hotwell stores condensate; usual capacity is about equivalent to one minute's operation. Larger hotwells may be used to meet particular plant conditions and sometimes an additional storage tank is installed below the hotwell.

Water boxes distribute cooling water to and from the condenser. Single-pass one-pump condensers have no division in either box. A single partition in inlet box gives a 2-pass setup; four sections in inlet and two in other handle 2-pass operation with two circulating pumps. Deep water boxes and careful location of inlet eliminate undesirable cross flow and turbulence at tube entrances.

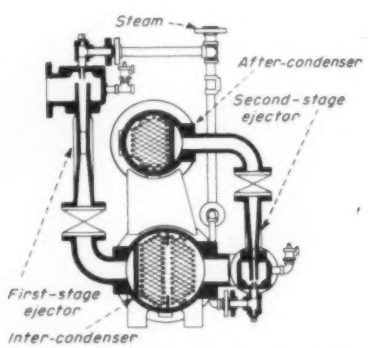
Shells. These are usually fabricated of copper-bearing steel, electric welded. Internal T sections, pipe reinforcing struts or I-beams built into the shell stiffen against external pressure and prevent distortion during shipping and erection. Reinforcing pads welded to shell carry supporting feet.

Support. Four basic condenser-support schemes have (1) condenser firmly anchored on foundation, with expansion taken in turbine exhaust pipe, Fig. 1 (2) exhaust pipe rigidly attached to condenser, with expansion taken in spring supports, Fig. 10 (3) condenser attached rigidly to exhaust pipe and suspended therefrom (4) condenser mounted on foundation and supporting turbine, Fig. 8.

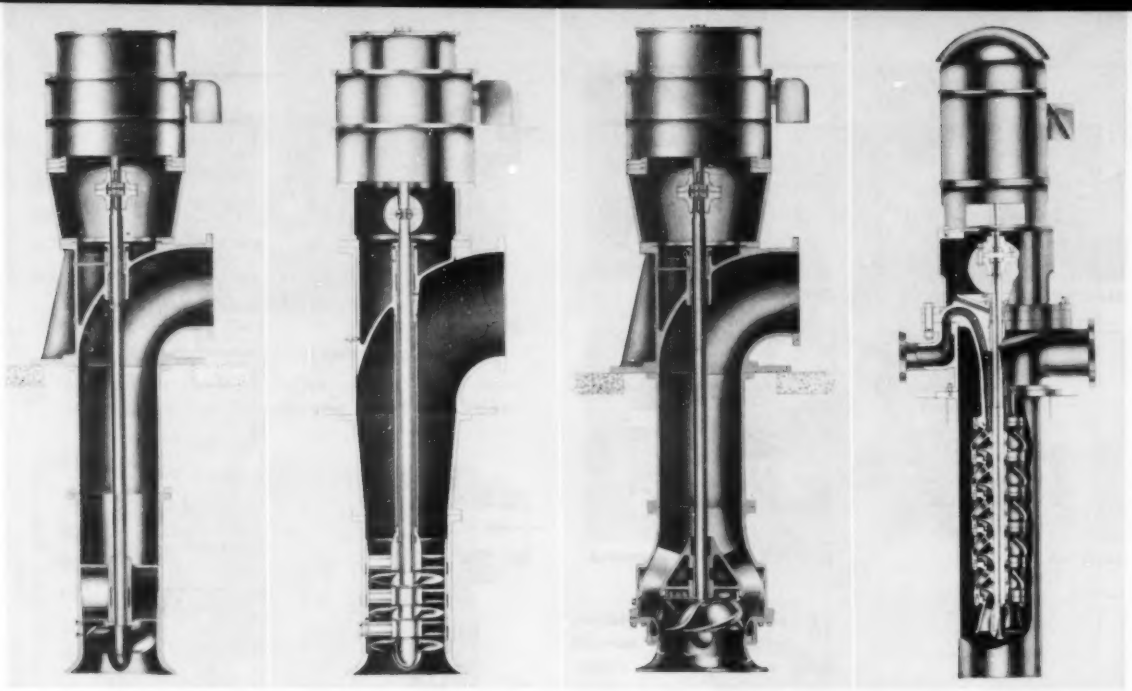
Differential expansion between shell and tubes may be taken care of by shell expansion joints, Fig. 9. Tube ends may be fixed and tubes bowed, with fixed or sliding support plates. Or one end of tubes may be fixed and



10 Spring supports may have weight they carry adjusted by hydraulic jack, *left*, or jackscrews, *right*. Support screws take condenser weight during hydrostatic test. No exhaust-pipe expansion joint would be used; springs take most of weight



11 Two-stage air ejector with inter- and after-condensers uses condensate for cooling. Drains return to condenser



12 Of three vertical circulating pumps above, two at left are propeller type, next is mixed-flow. Mixed-flow pumps operate at slower speed and produce higher head per stage

13 Vertical condensate pumps, *right*, are used where space limitations dictate. Pump submerged in vacuum-tight well extending below floor has right submergence without open pit

. . . we need to know a bit about auxiliaries: pumps, for example . . .

other end packed with fiber and metallic rings to allow tube to slide.

In addition to taking care of expansion, bowed tubes allow drainage when condenser isn't operating. Bowing of tubes has also been used to prevent tube vibration. In another scheme for cutting vibration, support-plate holes are machined to close tolerance and chamfered for a tight tube fit.

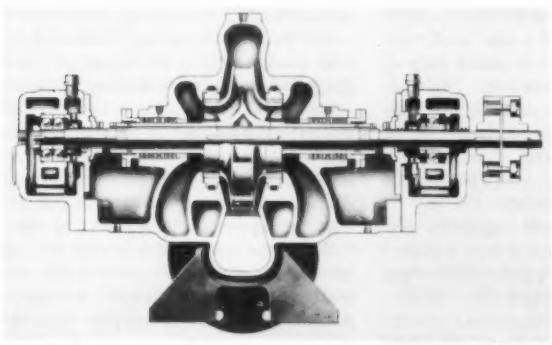
Today's tubes are usually expanded and flared at inlet and expanded or packed at outlet, Fig. 9. Serrations are sometimes used at inlets, as are ferrules, with or without packing. Belling inlets improves flow at tube entrances.

Air-Removal Equipment. Steam-jet air ejectors have largely replaced reciprocating and hydraulic-type vacuum pumps formerly used. A priming jet is sometimes needed for starting. On recent large installations, rotary air pumps have been used (POWER, Aug 1948, p 82). Ejectors offer low first cost, no moving parts, high air-removal capacity. In high-pressure and -temperature plants, rotary air pumps eliminate need for pressure-reducing valves, serve well where ammonia contamination is present, take care of both starting up and normal air-removal needs.

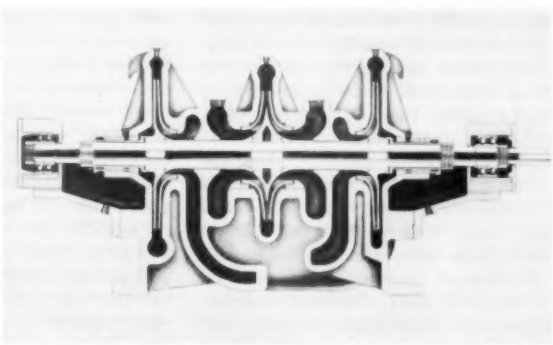
Common system has 2-stage twin-element air ejectors with condensate-cooled inter- and after-condensers. Inter-condenser drains back to condenser by a loop seal, after-condenser drains are trapped back. Drains are usually heated and deaerated in condenser.

Circulators. Many larger condensers have two half-capacity circulating pumps and a means for reversing water flow in the condenser (see below).

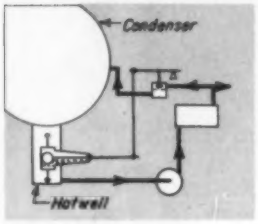
Circulating pumps may be centrifugal, Fig. 14; vertical propeller or mixed-flow types, Fig. 12. Propeller-



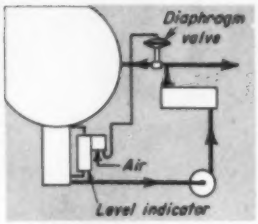
14 Centrifugal circulating pump, often used for low-capacity high-head application, can be used for high suction lift. Mounts horizontally or vertically; normally requires priming



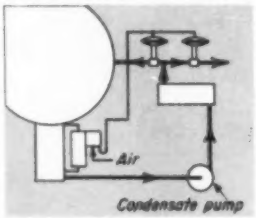
15 Horizontal 3-stage centrifugal condensate pump has double-entry first stage, opposed second- and third-stage impellers. Pressure in stuffing boxes keeps air from leaking in



Level driven



Level actuated



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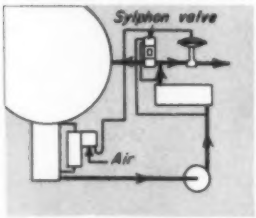
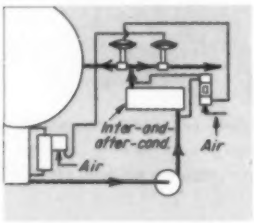


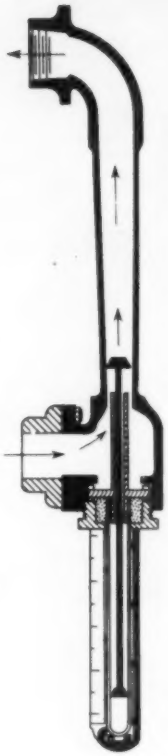
Level and temperature actuated

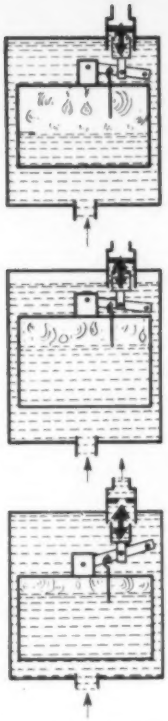


Level and temperature actuated

16 Some condensate recirculation schemes: hotwell level or temperature difference actuates control valves

17 Air-leakage meter's stem and disk float in conical passage to give constant drop in pressure across the disk





18 One type of vacuum trap to drain an after-condenser. Trap discharges when condensate weights down a bucket

. . . and other devices for keeping performance at top effectiveness

type pumps serve for medium or large flows. Driving motor mounts on top of pump, with a solid flanged coupling. This type takes minimum floor space and, in many cases, primes circulating system without external means. Multiple staging takes propeller pumps out of the low-head category.

Where it is necessary to have pump suction substantially below condenser, 75 to 80% of available discharge head can be used in a turbine driving a booster in series with primary pump.

Condensate pumps are usually centrifugals, either vertical or horizontal. Vertical type is usually a multistage pump taking suction from a pit into which condensate flows by gravity, or from a casing, Fig. 13. In both, sealing under pump discharge pressure prevents inward air leakage. Vertical pumps prove useful where there is little headroom; pump suction below floor level, thus well below hotwell level, gives adequate submergence.

Horizontal condensate pumps, Fig. 15, are often used with small and medium-sized condensers. Impeller arrangement (see caption) takes care of hydraulic unbalance. Most units have two full-capacity condensate pumps.

There are three basic methods of controlling hotwell level for safe operation: submergence (POWER, Nov 1948, p 74), condensate recirculation (Feb 1951, p 74), pump throttle control (March 1951, p 120).

Submergence is commonly considered as difference in elevation between hotwell level and pump centerline (horizontal pump). When condenser load decreases, so does amount of condensate, and pump drags down hotwell level, reducing amount of submergence. This lowers suction head on pump and output falls off. Conversely, with greater condenser load, submergence increases, giving a rise in suction head and thus increasing pump output.

Condensate recirculation, Fig. 16, keeps hotwell level essentially steady (constant submergence); amount of condensate recirculated is varied with load. At low loads, recirculation is greater than at high loads.

Pump throttle control regulates discharge so water pumped into condensate system always equals that flowing into hotwell from condenser. Difference between pump head and system head at a given flow is lost in the hotwell-level-actuated throttle valve.

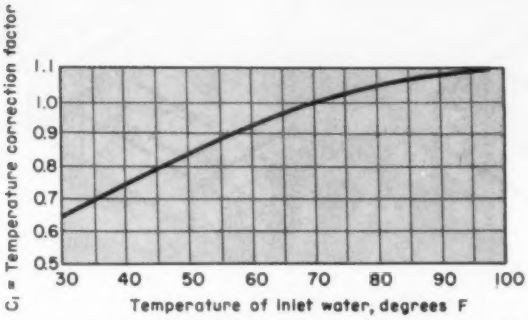
Other Equipment. Atmospheric relief valve in exhaust pipe protects condenser and prime mover in event of vacuum loss. Valve is usually of vertical-lift poppet type, designed to begin opening slightly above atmospheric pressure and to provide full relief at 5 to 10 psig. Valve is equipped with a hand-operated screw lift for non-condensing operation or test work.

Air-leakage meters are frequently installed in after-condenser vent piping. Various designs of piston-type meters follow the principle of Fig. 17; they're damped to give a steady reading. Orifice-type units are also used. Meters are calibrated to read in cfm.

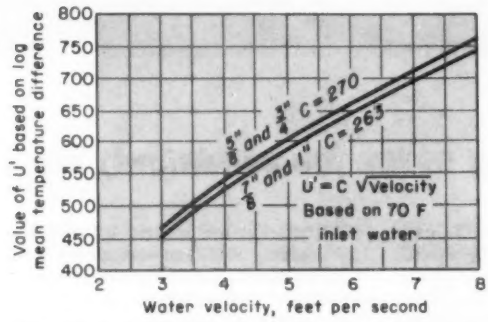
For proper operation, pressure gages and thermometers are installed where they give immediate warning of trouble.

Materials. Today's condenser shells are usually made of copper-bearing steel plate, with cast-iron or fabricated-steel waterboxes and manhole plates. Tube sheets are usually rolled muntz metal; supports copper-bearing steel.

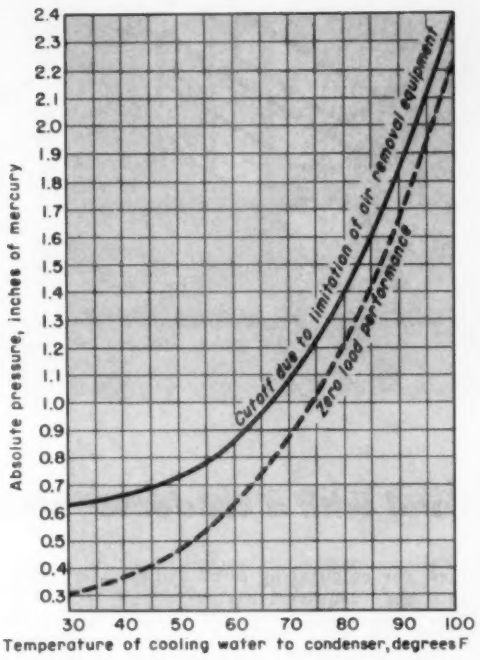
Tubes of inhibited admiralty metal or arsenical copper serve well with fresh circulating water. Admiralty metal (about 70% copper, 1% tin, 29% zinc) is inhibited with a few hundredths of a percent of arsenic, antimony or phosphorus. Arsenical copper has about 0.5% arsenic.



19 Temperature correction to be applied, along with other factors, to heat-transfer coefficient below



20 Transfer coefficient, Btu per sq ft heating surface, per degree log mean temperature difference, per hr



21 At low condenser loads these curves define expected pressures; are higher than those figured from *U*

Know-how on materials and design aids in choosing the right unit . . .

Aluminum brass (about 76% copper, 2% tin, 22% zinc, small amounts of lead, iron) is also inhibited with arsenic, shows high resistance to erosion by high-velocity aerated sea water.

Copper-nickel (70-30) became standard in American and British navies because of outstanding resistance to erosion and corrosion of sea water. Addition of about 0.5% iron further improves this resistance. Recently it has been found that low-nickel high-iron copper-nickel (say 10% nickel, 1% iron) has properties comparable to 70-30 copper-nickel and is less costly.

Tube Life. Two variables affecting tube life that can be altered are the tube material and the hydraulics of the condenser system. Flow factors causing tube deterioration are: turbulence from non-uniform velocities or other causes; increase in water velocity causing decrease in pressure, or decrease in pressure causing release of air bubbles; vortex in tube with air center; free air entering the system. These items may be minimized by water box design, keeping velocity of entering water as low as possible, arranging angle of entry to water box to eliminate vortices, excluding free air. (POWER, March 1951, p 122).

Selecting a condenser involves considering: (1) steam flow to condenser, (2) cooling-water temperature (3) absolute presure desired (4) water velocity through tubes (5) number of water passes (6) effective length, size, gage, and material of tubes (7) cleanliness factor. Wrapped up in these considerations are quantity and quality of water source, space and accessibility requirements and economic factors.

Once over-all requirements have been established, actual heat-transfer design can go ahead. Basic formula involved is $Q = U \times A \times \Delta t$ (p 78). Q is total heat (Btu per hr) to be extracted in condensing steam and is equal to lb of steam times actual enthalpy removed per lb, at condenser pressure. U is over-all coefficient in Btu per sq ft per F per hr, A is total effective tube surface in sq ft, and Δt is log mean temperature difference. With physical factors established, Q, U and Δt can be calculated and formula solved for effective tube surface.

Values of U' in Fig. 20 are uncorrected. Factors for inlet-water temperature, tube gage and material, and cleanliness must be applied to get proper over-all heat-transfer coefficient. The temperature correction is given in Fig. 19. Corrections for tube gage and material are given in *Heat Exchange Institute Standards for Steam Surface Condensers;* they range from 1.0 for 18 BWG admiralty to 0.76 for 16 BWG 70-30 copper-nickel. Commonly used cleanliness factor is 0.85.

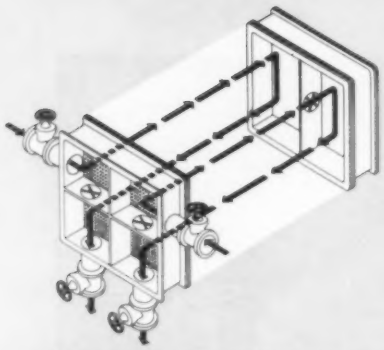
Performance curves show condenser-pressure variation with Btu load. Once design point is fixed, use of heat-transfer and lmtd formulas gives a family of such curves, one curve for each cooling-water temperature and flow.

But at low loads and pressures performance departs from these curves because air-removal equipment doesn't maintain theoretical vacuum. So curves are corrected by use of Fig. 21.

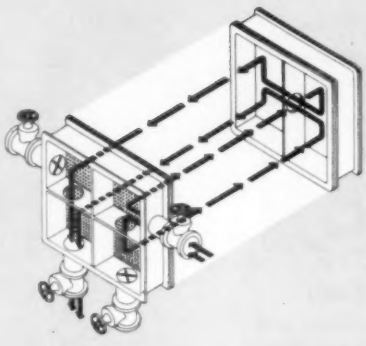
Upper line, Fig. 21, gives lower limit of pressures for which U holds. For any given temperature this fixes a point on the performance curve called the "cutoff." From here down, pressure varies in a straight line, the lower end of which, at zero Btu load, is given by lower curve in Fig. 21.

For each water temperature, cutoff point occurs at a different load. Above cutoff point, U value holds if terminal difference is not less than 5F.

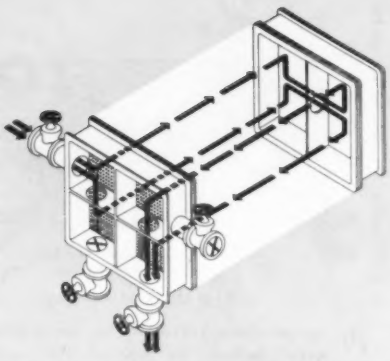
The *HEI Standards* give curves for loss of head in the tubes and the water



22 Normal flow in a divided-water-box condenser, partition valves closed



23 With only one pump running, reverse flow is obtained in two of sections



24 Remaining sections can be backwashed by using other circulating pump

...and with a condenser properly fitted to the job conditions, we...

boxes, for calculating circulating-pump head requirements.

Low vacuum can be caused by increased air leakage, reduced circulating-water flow, tube scale or slime accumulation, or plugging of air-ejector jets. It's helpful to know your condenser's normal air leakage. Shortly after unit is started up, check the air leakage. If it's higher than normal, take steps to reduce it.

Source of air leakage may be found in several ways: (1) Put shell under air pressure and note effect of soapy water at likely points. (2) With condenser in service, put peppermint oil on suspected joints and check air-ejector discharge for peppermint odor. (3) For large leaks, pass a candle flame over possible openings when condenser is under vacuum. (4) Fill shell and exhaust pipe to turbine shaft with water; check outside of shell for leakage.

To check operation of air ejector, turn on standby ejector instead of suspected unit; see if vacuum improves.

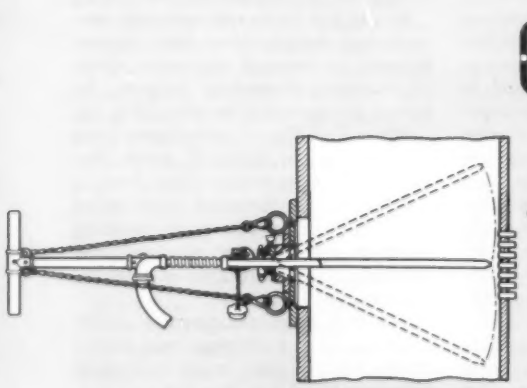
Reduced Water Flow. Temperature rise of circulating water will be greater and vacuum poorer when circulating flow isn't adequate. With pumps and piping in proper condition, low flow may be caused by foreign material in water passages of condenser and inlet screen, or by accumulation of air in water boxes due to improper venting.

Foreign matter blocking flow may be removed by flow reversal, Fig. 22-26. By opening valve in water-box partition of 2-pass condenser, inlet water bypasses to outlet, clearing tube sheets by cross flow. Hydraulic flushing nozzle, Fig. 27, is another means of removing flow restrictions, as is manual cleaning with condenser shut down.

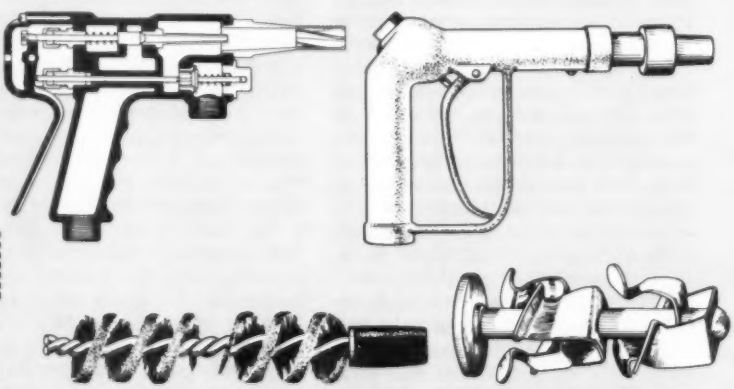
Tube leaks are spotted by candling, hydrostatic tests, and various forms of leak detectors. Recently, good results have been obtained by using a fluorescent solution and ultra-violet light (POWER, July 1950, p 96).

Keeping Tubes Clean. In normal condenser operation, absolute pressure in shell and entering and leaving water temperatures are known. By various means, cooling-water flow can be approximated. Then with tube surface known, over-all coefficient of heat transfer can be calculated, see p 97.

Such coefficients can be set up for various operating conditions when the tubes are new and clean, air leakage is within prescribed limits, and air-evacuating equipment is working properly. These are "clean-tube" coefficients — 1.00 cleanliness factor — for the specific conditions from which obtained.

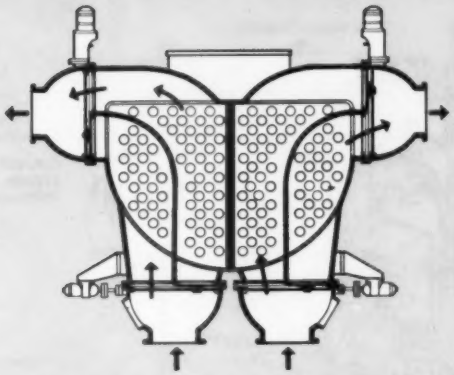


27 Hydraulic tube and water-box flushing nozzle is used to loosen debris while condenser operates



28 Water or air-and-water guns drive plugs or brushes through tubes for cleaning. "Projectile" scrubs or cuts depending on its design

25 Circulating-water reverse-flow valve for 2-pass condenser, shown in its two operating positions, allows backwashing with a single pump



26 Backwashing scheme built into water box. To reverse: change inlet, outlet valve positions

. . . find that sound operation and top maintenance come a lot easier

After condenser has been operating for a while, again calculate heat-transfer coefficients. Then, if air leakage is within limits and evacuating equipment operating properly, ratio of coefficients to those for clean tubes under corresponding conditions is cleanliness factor. This measures how effective tube-cleaning methods are, shows if cleaning is needed.

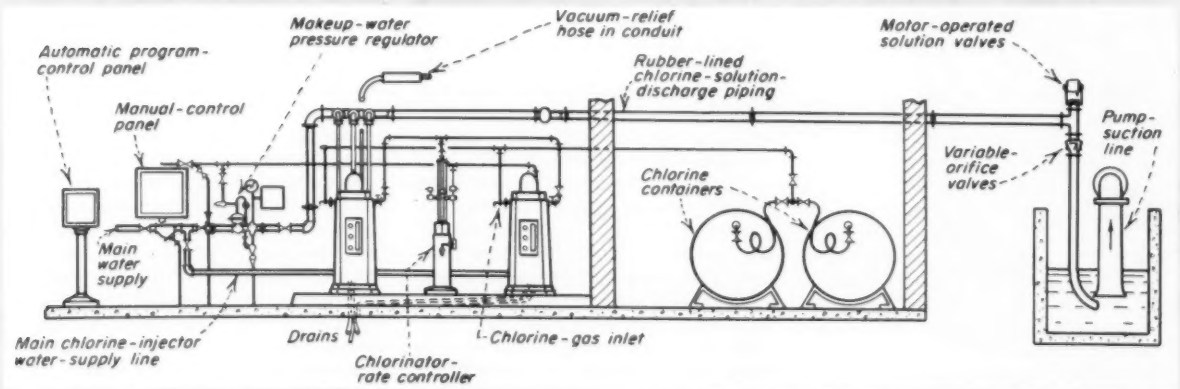
Getting Rid of Slime. Use of chlorine or chlorine compounds in circulating water is usually effective in preventing buildup of slime, which destroys initial tube cleanliness. Slime consists of minute living organisms, colonies of which tend to trap and hold suspended solids from the water. The chlorine poisons these organisms, preventing their growth on the tubes.

Chlorine or chlorine compounds are injected into water ahead of the circulating pump, Fig. 29. Amount of chlorine needed is determined by biological examination of organism's growth, or by experiment. In one plant, for example (POWER, Nov. 1948, p 79), two injections per day, yielding relatively high concentrations of 10 to 15 ppm, give good results. If slime is key problem, proper chlorination keeps condensers in service for long periods.

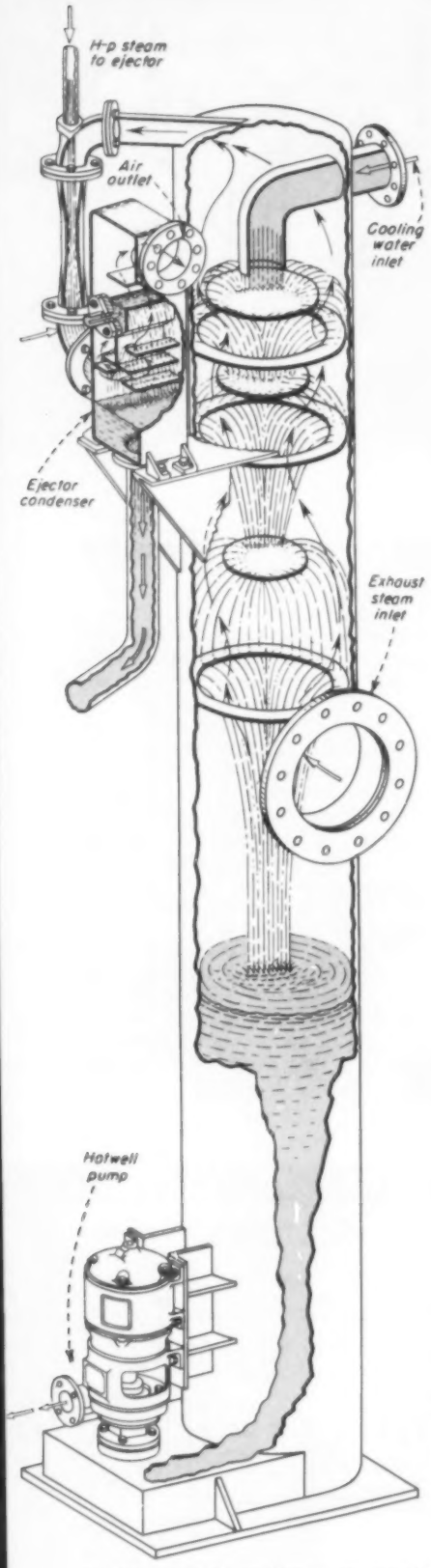
Cleaning Methods. If slime or scale build up, condenser can be cleaned mechanically or chemically, while shut down. In usual mechanical cleaning, air or water under pressure drives brushes or plugs through the tubes, Fig. 28. Brushes scrub, and in some cases scrape, accumulations from tube surfaces. Whether brush has continued scraping action depends on the bristle. Rubber plugs remove loose slime, but may compact remaining slime onto tube surface. Metal plugs usually have flexible scrapers, which give when they hit a solid obstruction. Metal plugs remove hardened slime coatings and any scale that may be deposited.

Special alkaline mixtures held for several hours at 180 F do a good job of removing compacted slime and oily or greasy deposits on tube interiors. Calcium and silica scales can be removed by a weak inhibited-acid solution. For personnel safety and to prevent damage to condenser, acid cleaning should be done with expert advice and supervision.

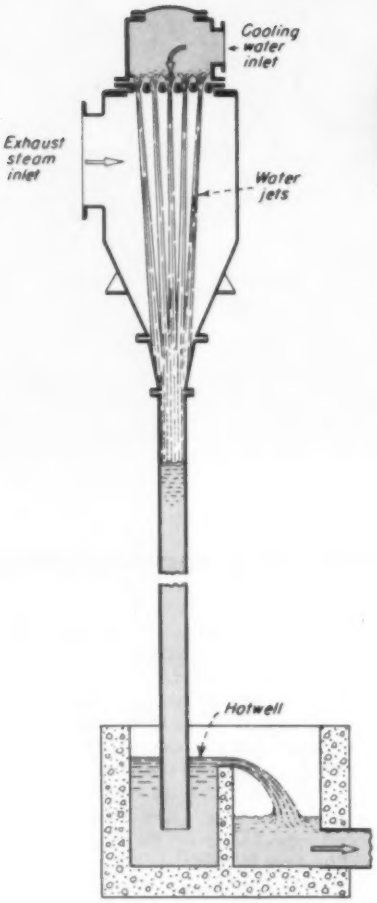
On the steam side, deposits of boiler compound, rust, and sometimes oil, may be removed by boiling out with alkaline solution. Steam-side deposits are usually thinner, less resistant to heat flow than those on water side. Thus cleaning is usually infrequent.



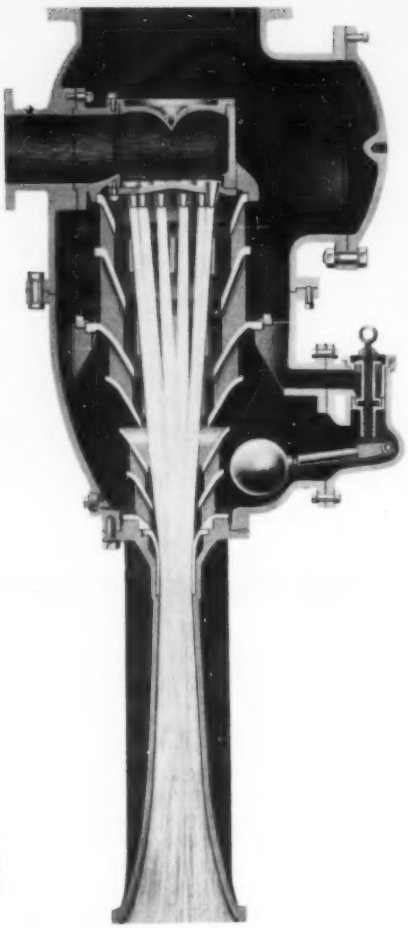
29 Intermittent injection of chlorine or chlorine compounds into circulating water ahead of pump removes slime. This may be done a few minutes every hour or for longer periods once a day. Usual chlorine concentrations in water: 2-4 ppm



1 Floor-mounted countercurrent contact condenser for process work employs single-stage air ejector for evacuation



2 This ejector-jet parallel-flow contact barometric condenser needs no pump to remove entrained non-condensibles



3 Low-level multi-jet condenser has a float-operated vacuum breaker to prevent flooding of the steam exhaust lines

Barometric and jet units...

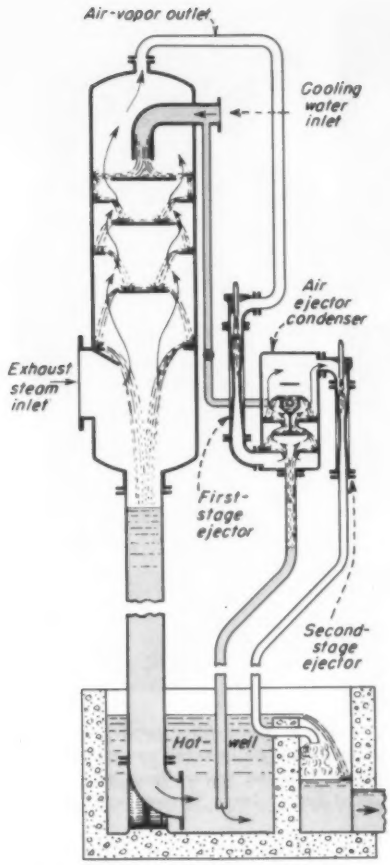
These exchangers condense exhaust steam by direct contact with cooling water. They are simple, compact and low in first cost, but condensate mixes with raw water. Thus jet and barometric units often find use where loss of condensate isn't important, or where raw water is cheap and easily treated and makeup needs aren't stringent.

These condensers may be classified as: (1) barometric, or (2) low-level jet. Each may be either: (*a*) counterflow, or (*b*) parallel flow. First classification refers to method of removing water from unit, second to relative flows of steam and cooling water.

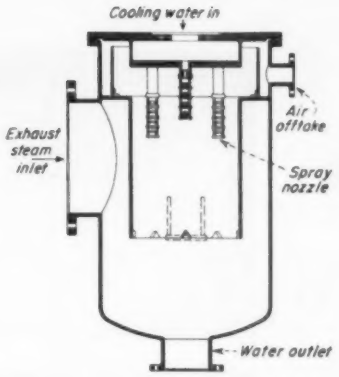
Barometric condensers, Fig. 2 and 6, have shells elevated above discharge water level so water leg in tail pipe has enough head to drain the mixed cooling water and condensate from the evacuated shell. Shells in Fig. 4, 5 and 7 can also be arranged this way (tail pipes aren't shown). Notice that tail pipe seals condenser shell as well as providing head for drainage. Water level in tail pipe depends on both vacuum in shell and barometric pressure.

In counterflow units, steam with its noncondensables flows in a direction opposite to that of cooling water, Fig. 1, 4 and 6. In parallel-flow units, steam and water flow the same way, Fig. 2, 3, 5 and 7. In many designs, cooling water breaks up into a spray to present most surface for steam absorption, Fig. 1, 4, 5, 6 and 7. In these units, noncondensables must be removed by an air pump, as shown in Fig. 1, 5 and 6.

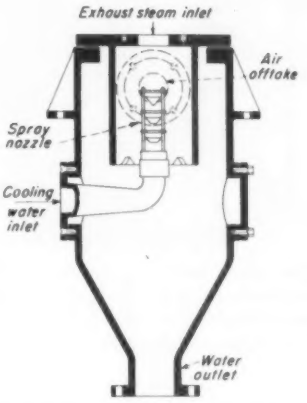
Low-level jet condensers use some type of pump to remove the water mixture from the shell. Unit in Fig. 1



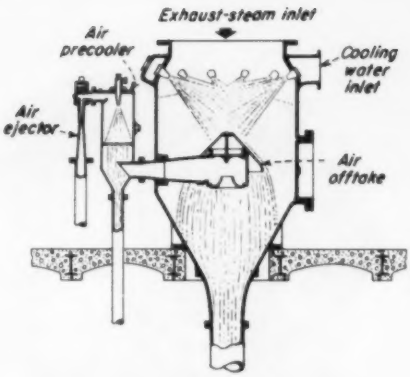
6 Countercurrent barometric condenser uses disks to break up water flow, 2-stage air ejector with intercondenser



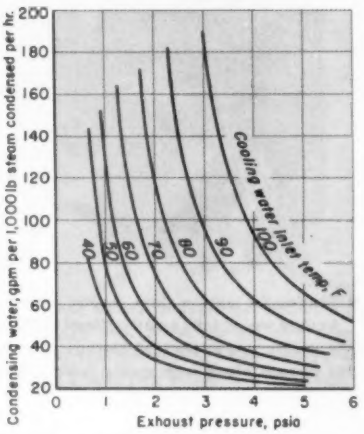
4 Countercurrent barometric condenser has steam and non-condensibles pass up through cooling-water spray, center



7 Small parallel-flow barometric condenser often used as inter- and after-condensers of steam-jet air ejector



5 Air suction chamber, center, draws off non-condensibles for removal by steam-jet air pump through a precooler



8 Flow of cooling-water increases with decreasing exhaust pressure and rising temperature of inlet cooling water

they fit where makeup is good and low-cost

does this by a vertical centrifugal pump at the bottom of the hotwell. In Fig. 3, it's done by the jet action of the cooling water entering the diffuser (at shell bottom) at high speed. Any of the other condensers shown here can use a centrifugal pump connected to the bottom of the shell to remove water.

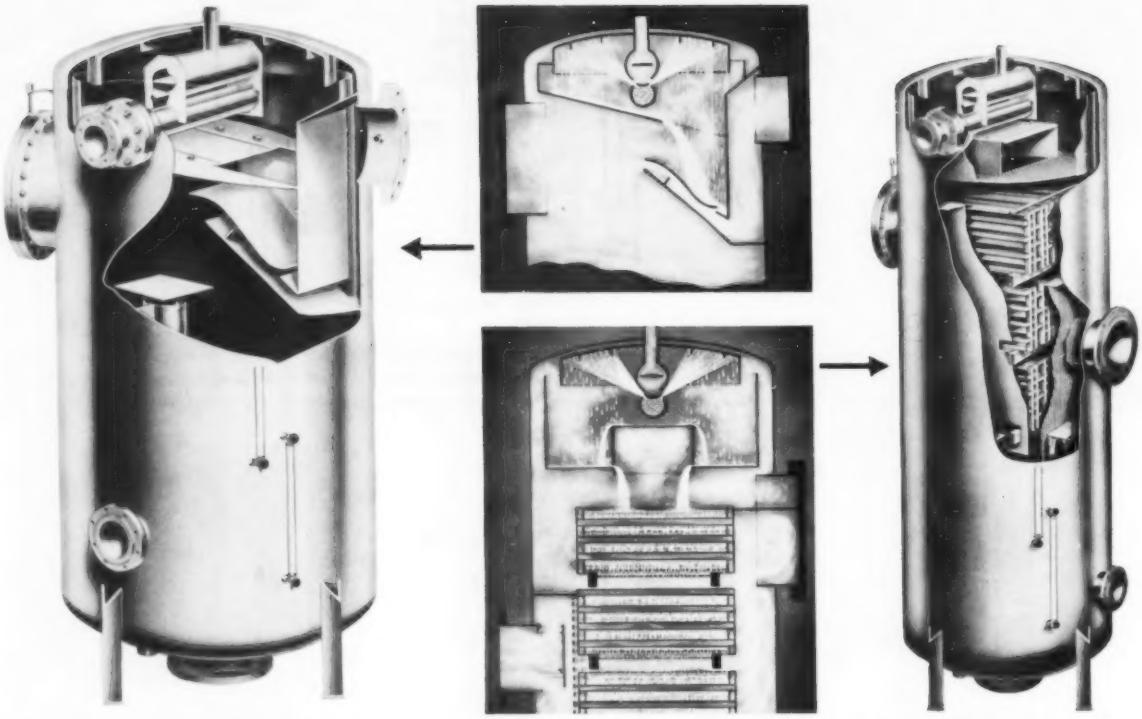
Condensers using water jets, Fig. 2 and 3, do not need a separate air offtake to remove noncondensables. Speed of the jets entrains gases and carries them out with the drainage water. To realize this entraining action, the water cannot be broken up into a spray to get maximum heat-transfer surface, but the steam condenses on the surface of the fast-moving jet streams. In Fig. 3, the annular diffuser arrangement surrounding the jets directs steam entering at the top of the shell into the jets for absorption.

Performance. Amount of cooling-water flow needed by a condenser depends on vacuum to be held and amount of steam being condensed. Fig. 8 shows the relation for counterflow condensers serving steam turbines. These curves are based on 950 Btu per lb in exhaust steam. For parallel-flow units this relation is slightly different.

In well-designed contact condensers there will be little pressure drop between steam inlet and air offtake for small amounts of gases in the steam. When the noncondensable load builds up, pressure drop increases accordingly and backpressure held by the condenser rises. Air in the steam caused by leakage through porous walls and joints in the exhaust system, and leaks past shaft seals, can usually be kept at levels varying from 3 cfm for steam flows of 25,000 lb per hr to 10 cfm for flows of 250,000 lb per hr, when serving turbines. The cooling water carries in a certain amount of dissolved air that releases in the evacuated shell. Designers allow for this at rates varying from about 2 cfm per 1000 gpm at 100-F inlet temperature to 4 cfm per 1000 gpm at 35 F. This air must also be removed with the noncondensables entering with the steam.

Fig. 3 shows a float-operated vacuum breaker to keep discharge water from backing up into the condenser and flooding turbine exhaust system.

For aid in specifying conditions for contact condensers, refer to *Standards of Heat Exchange Institute—Barometric and Low-Level Jet Condensers.*



1 Feedwater sprays into upper chamber filled with steam, heated water falls on an inclined baffle below. Entering steam jets it into upper part of storage chamber, scrubbing out gas. Gas sweeps along with steam, leaves through vent in top center

2 Feedwater spray is heated in steam-filled upper chamber. Water collects on baffles and falls in drops and thin sheets on deaerating trays below. Entering steam flows over trays and carries along released gas to leave through vent at top

Deaerating heaters... *they remove gases*

Deaerating heaters raise feedwater temperature by direct contact (mixing) with steam, and remove all dissolved oxygen in excess of 0.03 ml per liter. When the unit can reduce the dissolved oxygen to 0.005 ml per liter it is called a *deaerator*. Removal of dissolved gases depends on heating the water to boiling, agitating it and presenting as big a surface as possible to liberate the gas and absorb heat by condensing the steam.

Spray Heaters. Two types of heaters do this job: (1) spray and (2) tray. Methods may be combined. In the spray type, Fig. 1, 5 and 7, the feedwater sprays into a steam-filled space, to be heated and scrubbed for gas release. In these three examples, the water undergoes a second agitation by the steam entering the deaerator. This releases the last remaining portion of dissolved gases that can be removed before the hot water leaves the heater.

Tray and Combination Types. In the tray type of heater, Fig. 4, feedwater is led into a series of trays and falls from tray to tray by overflowing or passing through small holes. Steam completely envelopes the trays, heats and deaerates the water during its trip to the bottom of the shell. In combination-type heaters, Fig. 2, 3 and 6, feedwater first sprays into a steam-filled space and then rains down on top of a series of trays through which it passes to be further agitated or scrubbed for gas release.

In entering a deaerating heater, steam usually meets the hottest water first, to work on the last fraction of dissolved gas. It carries this gas with it as it flows through the countercurrent water, picking up additional gas load along the way. The steam also condenses partly as it heats the feedwater along this route. Steam reaches the top of the heater rich in gases. When this mixture meets the cooler incoming feedwater, almost all the remaining steam condenses. The gases saturated with steam then leave the heater through the vent.

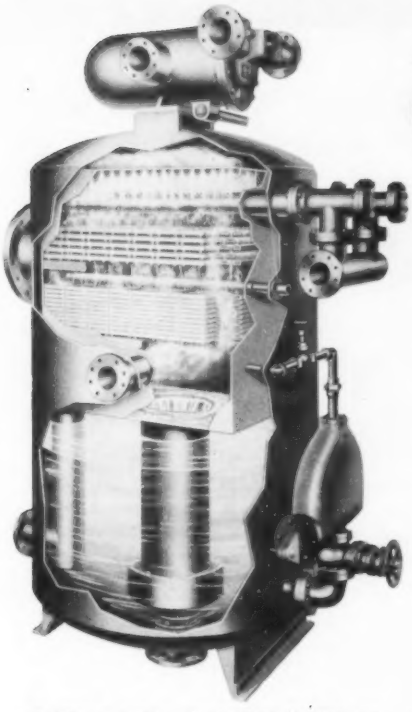
Some heaters, Fig. 3, have incoming steam and water meeting in the same area of the heater and moving down in parallel flow to the heater bottom.

Vent Condensers. These elements cool the vented steam-gas mixture with colder incoming water to condense as much of the steam as possible. Condensate returns to the heater. Condensers may be of the direct-contact type, Fig. 1, 2, 5 and 6, or the shell-and-tube type, Fig. 3, 4 and 7.

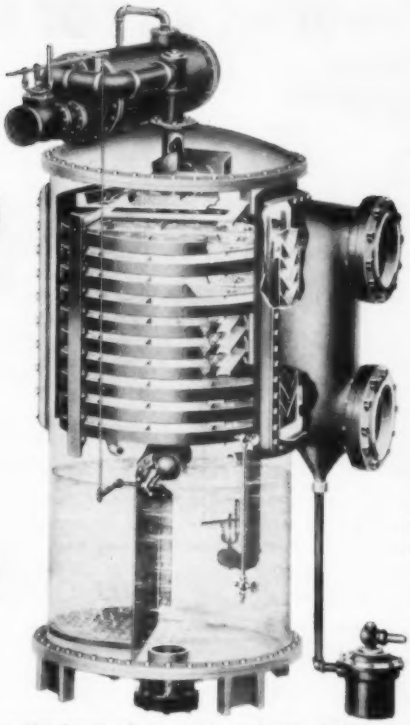
Deaerating heaters may operate at pressures as high as 200 psig, or under vacuum. In the latter case they vent their gases to an evacuating pump, or the main condenser.

Since the wet gases can be corrosive, deaerator internals must be made of corrosion-resistant materials such as stainless steel or monel.

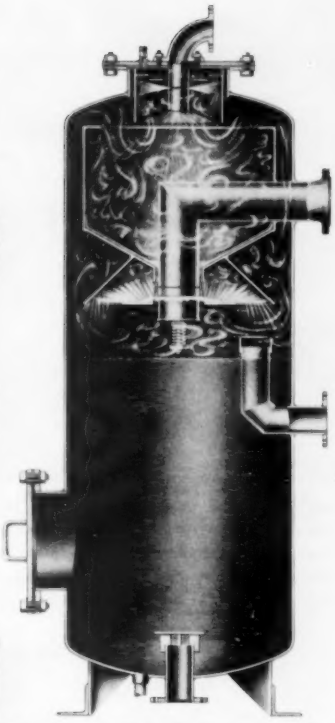
Most heaters have automatic control valves to admit makeup when storage level drops too low, and to pass heated, deaerated water to storage when level rises too high, see Fig. 3, 6 and 7. For details of these heater types see *Standards and Typical Specifications for Deaerators and Deaerating Heaters*, issued by the *Heat Exchange Institute*.



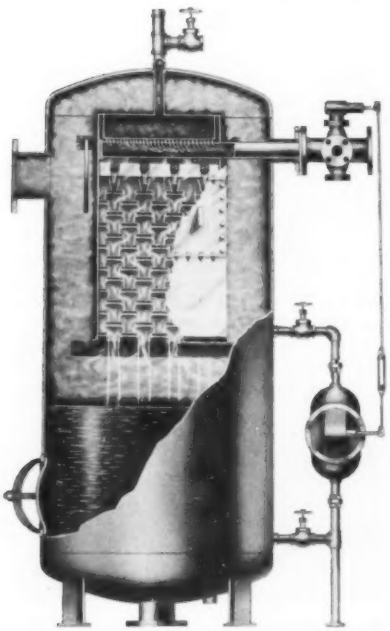
3 Steam enters deaerating heater, *upper left*, to meet sprayed inlet water at top. Both flow down through trays; wet gases leave through outlet at center



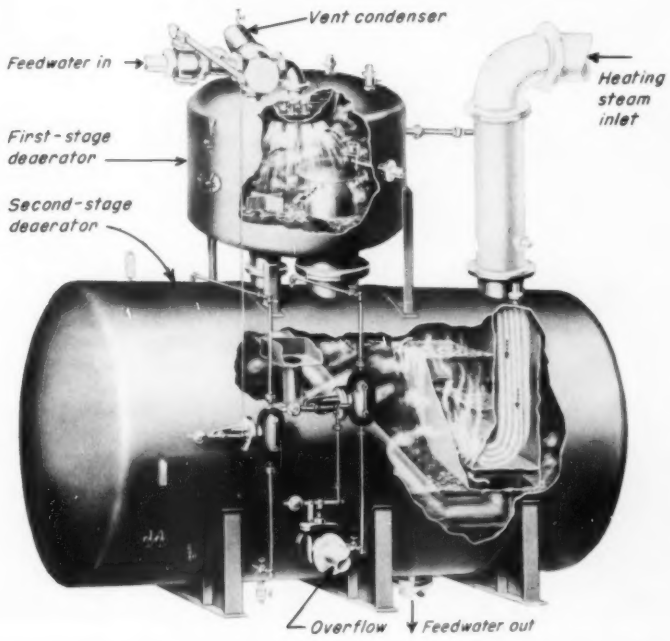
4 Feedwater from vent condenser falls on top tray and works its way down from tray to tray in a zigzag course, being heated and deaerated on the way



5 Water enters through top elbow; part sprays into direct-contact vent condenser, rest forms the main deaerating spray. Steam jets water into final spray

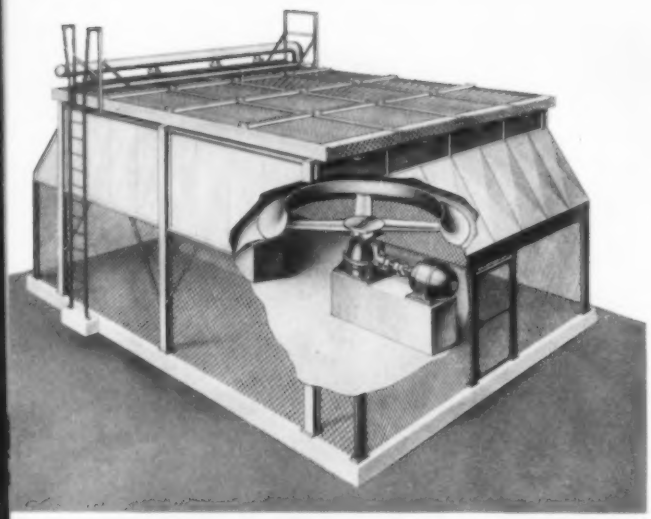


6 Water sprays up into a chamber above trays, falls down from tray to tray. Steam flows countercurrent upward past trays. This degasifies and heats water

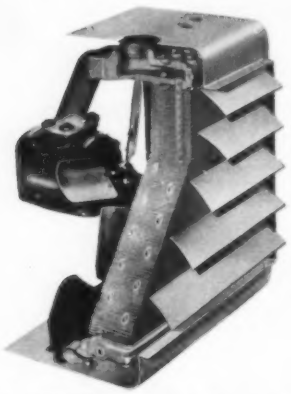


7 First-stage deaerator receives water in spray form, where steam heats it and removes most of dissolved gases. Water flows down inclined pipe into second stage where incoming steam bubbles through it and removes remaining gases. Steam, carrying gas along, rises into first stage to heat incoming water close to boiling

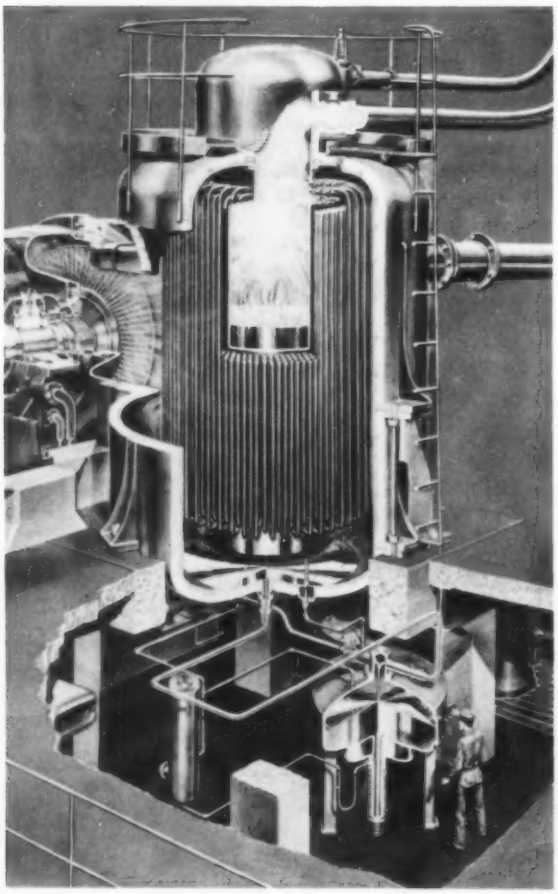
For special jobs...



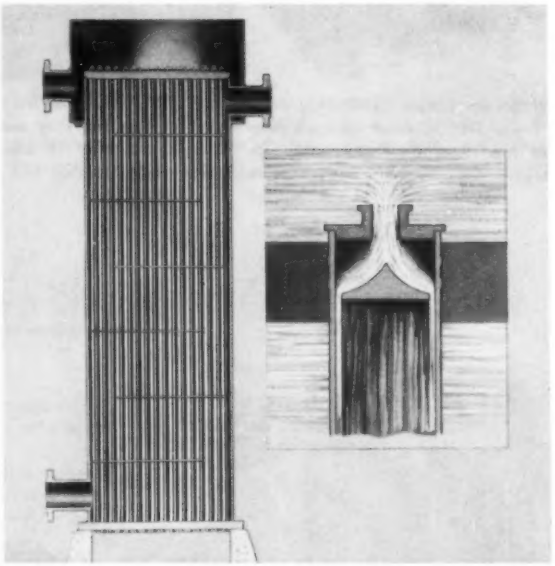
DRY COOLERS may be used for fluid cooling or condensing service. Diesel-engine jacket-water cooling and turbine exhaust-steam condensing are typical applications. Motor-driven fans force air over finned tubes carrying fluid in a closed circuit. There's no contamination and no evaporation loss



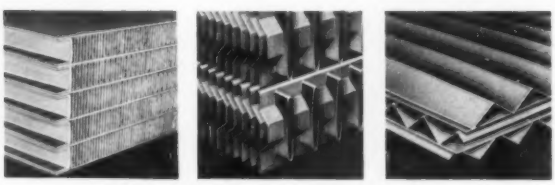
LUBRICATING-OIL RADIATOR is a form of small dry cooler used in areas where cooling water is scarce. Motor-driven fan may be thermostat-controlled for automatic operation. Oil circulates between upper and lower headers through vertical finned tubes. Air side needs most heat-transfer surface



MERCURY CONDENSER-BOILER takes exhaust from mercury turbine; evaporates feedwater to saturated steam in tubes and central vertical drum. Condensed mercury falls to hotwell in basement for return to mercury boiler. Steam flows to superheater in boiler before entering the steam turbine

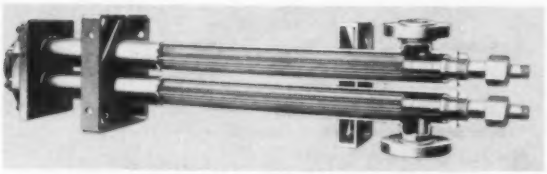


FILM-TYPE COOLER handles silt-laden water as a cooling medium. Water from river or well enters top channel, which is open to atmosphere. From here water flows through ferrules in upper ends of tubes, *inset right*. Ferrules cause water to flow down interior tube wall in thin film to bottom

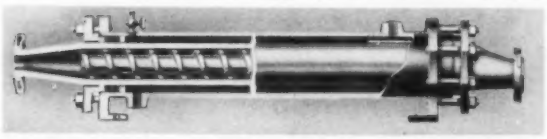


PROCESS HEAT EXCHANGERS handling gases must overcome problem of poor film heat-transfer coefficients by making available maximum possible amount of heat-transfer surface. This is done by extended surfaces of various shapes formed to produce desired turbulence with minimum of pressure loss

heat exchangers can be tailored to the needs

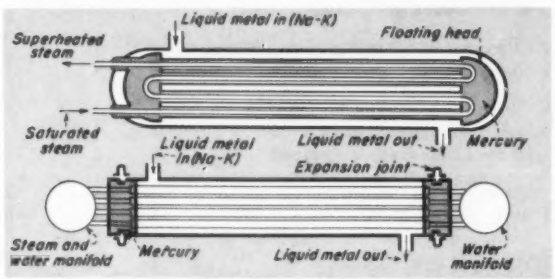


DOUBLE-PIPE EXCHANGER with finned-tube surface often serves as fuel-oil heater, to lower viscosity. Steam serves as heating medium. These units can be hooked up in series to give total amount of heat-transfer surface needed to do job



LUBRICATING-OIL COOLER of small capacity uses annular-pipe arrangement. Core in center tube makes oil take helical path at high velocity. Cooling water flows through annular space between tubes, making one pass. Cock vents space

BLOWDOWN HEAT EXCHANGER of small capacity takes blowdown from boiler through a small tube. Makeup entering feedwater cycle passes through surrounding pipe. Blowdown goes to waste, but heat that would otherwise be lost is salvaged



LIQUID-METAL STEAM SUPERHEATER for atomic plant uses mercury between tubes to prevent a disastrous reaction between steam and sodium-potassium mixture, in case of tube-joint leakage or accidental tube rupture on either side of heater

LIQUID-METAL STEAM BOILER normally stands in tilted position with water manifold at a lower level. Mercury in annular spaces between tubes isolates the liquid metal from water in case of accidental leakage. Note expansion joints

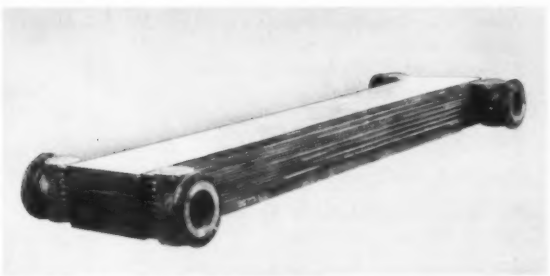
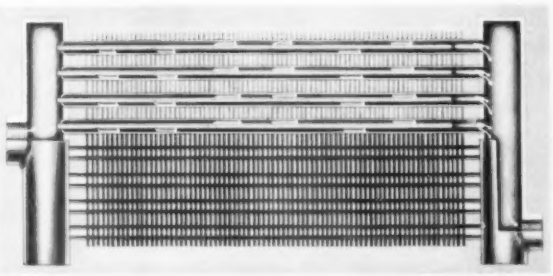
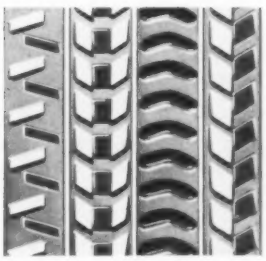
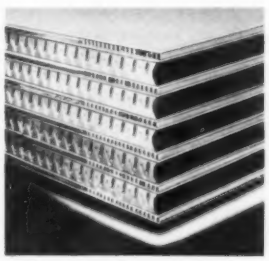


PLATE-TYPE EXCHANGERS may have plain open passes or use extended-surface passages such as those shown below and at lower left. These are used for air and gases. Note that manifolds at right and left ends tie into alternate passages between plates. Clean gases must be used to prevent fouling

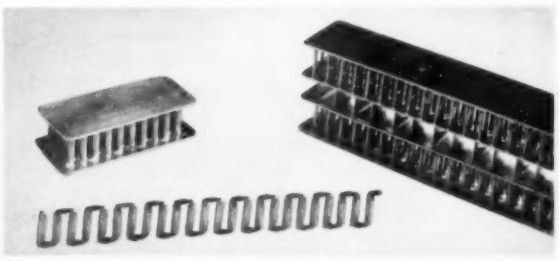


STEAM-HEATING EXCHANGER with finned tubes may be placed in duct to heat air flowing over fins. Center tubes distribute steam along length to get more effective duty from all of surface. Similar finned-tube arrangements are used in generator hydrogen coolers with cooling water flowing in tubes





EXTENDED SURFACE may be embossed in various ways, *left*, to induce turbulence in gas flowing between plates, *right*. Note thin cross-section with channel separators makes gas flow at right angles to gas in channels with embossed plates. Extensive heat-transfer data are used in designing surfaces



PIN-FIN SURFACE developed for gas-turbine regenerators is compact, light. Pins may be circular in section or streamlined, *foreground*. They are machine-formed in continuous strands, with lugs for brazing to plates. Pins can be used in each passage, or alternated with strip fins, as at right

SUMMARY OF TYPICAL HEAT-EXCHANGER APPLICATIONS

	Heat-transfer fluids	Equipment	Action	Type	Pressure range	Typical range of U
HEATING	Liquid—liquid	Boiler-water blowdown exchanger	Blowdown cooled, feedwater heated	S	M, H	50—300
		Laundry-water heat reclaimer	Waste water cooled, feed heated	S	L	30—200
		Service-water heater	Waste liquid cooled, water heated	S	L, H	50—300
	Vapor—liquid	Bleeder heater	Steam condensed, feedwater heated	S	L, H	200—800
		Deaerating feed heater	Steam condensed, feedwater heated	M	L, M	DC
		Jet heater	Steam condensed, water heated	M	L	DC
		Process kettle	Steam condensed, liquid heated	S	L, M	100—500
		Oil heater	Steam condensed, oil heated	S	L, M	20—60
		Service-water heater	Steam condensed, water heated	S	L, M	200—800
		Open flow-through heater	Steam condensed, water heated	M	L	DC
		Liquid-sodium steam superheater	Sodium cooled, steam superheated	S	M, H	50—200
	Gas—liquid	Waste-heat water heater	Waste gas cooled, water heated	T	L	2—10
		Boiler economizer	Flue gas cooled, feedwater heated	T	M, H	2—10
		Hot-water radiator	Water cooled, air heated	T	L	1—10
	Gas—gas	Boiler air heater	Flue gas cooled, combustion air heated	T, R	L	2—10
		Gas-turbine regenerator	Flue gas cooled, combustion air heated	T	L	2—10
	Vapor—gas	Boiler superheater	Combustion gas cooled, steam sup'h't'd	T	M, H	2—20
		Steam pipe coils	Steam condensed, air heated	T	L, M	2—10
		Steam radiator	Steam condensed, air heated	T	L	2—10
COOLING	Liquid—liquid	Oil cooler	Water heated, oil cooled	S, D	L, M	20—200
		Water chiller	Refrigerant boiled, water cooled	S	L, M	30—150
		Brine cooler	Refrigerant boiled, brine cooled	S	L, M	30—150
		Transformer-oil cooler	Water heated, oil cooled	S	L, M	20—50
	Vapor—liquid	Boiler desuperheater	Boiler water heated, steam desup'h't'd	S, M	M, H	150—800
	Gas—liquid	Compressor inter- and after-coolers	Water heated, compressed air cooled	S	L, H	10—20
		Internal-combustion-engine radiator	Air heated, water cooled	T	L	2—10
		Generator hydrogen, air coolers	Water heated, hydrogen or air cooled	S	L	2—10
		Air-conditioning cooler	Water heated, air cooled	T	L	2—10
		Refrigeration heat exchanger	Brine heated, air cooled	T	L, M	2—10
		Refrigeration evaporator	Refrigerant boiled, air cooled	T	L, M	2—10
	Vapor—gas	Boiler desuperheater	Flue gas heated, steam desuperheated	T	M, H	2—8
BOILING	Liquid—liquid	Hot-liquid evaporator	Waste liquid cooled, water boiled	S	L, H	40—150
		Liquid-sodium steam generator	Sodium cooled, water boiled	S	M, H	500—1000
	Vapor—liquid	Evaporator (vacuum)	Steam condensed, water boiled	S	L	400—600
		Evaporator (high pressure)	Steam condensed, water boiled	S	L, M	400—600
		Mercury condenser-boiler	Mercury condensed, water boiled	S	M, H	500—700
	Gas—liquid	Waste-heat steam boiler	Flue gas cooled, water boiled	T	L, H	2—10
		Direct-fired steam boiler	Combustion gas cooled, water boiled	T	L, H	2—10
CONDENSING	Vapor—liquid	Refrigeration condenser	Water heated, refrigerant condensed	S, D	L, M	80—250
		Steam surface condenser	Water heated, steam condensed	S	L	300—800
		Steam mixing condenser	Water heated, steam condensed	M	L	DC
		Inter- and after-condenser	Condensate heated, steam condensed	S	L	15—300
	Vapor—gas	Air-cooled surface condenser	Air heated, steam condensed	T	L	2—16

EXPLANATORY NOTES

Letter designations under "Type": *S*—shell-and-tube exchanger; *M*—direct-contact mixing exchanger; *T*—tubes in path of moving fluid, or exchanger open to surrounding air; *R*—regenerative plate-type or simple plate-type exchanger; *D*—double-tube exchanger.

Designations under "Pressure range": *L*—highest pressure ranges from 0 to 100 psia; *M*—highest pressure from 100 to 500 psia; *H*—500 psia up.

Values of *U* represent range of over-all heat-transfer coefficients that might be expected in various exchangers. Coefficients are stated in Btu per hr, per F, per sq ft of heating surface. Total heat transferred in exchanger, in Btu per hr, is obtained by multiplying a specific value of *U* for that type of exchanger by the surface and the log mean temperature difference. *DC* indicates direct exchange of heat.

Igor J Karassik, Manager, Multistage Pump Section, Centrifugal Pump Division, Worthington Corporation, in the last of his series, concisely summarizes the findings of his five previous articles on . . .

High-speed feed pumps for superpressures

PUMPS:

High speeds—9000 to 15,000 rpm—are a certainty because of the advantages obtainable with them at pressures above 2500 psi

Pressure per stage may rise to 500-1000 psi, compared with 300 psi now

Discharge pressures as high as 6000 psi present no problems in the design and construction of the pumping units and their drives

Spare pumps probably will not be used because outages will be so infrequent that the extra investment cannot be justified

Closed-heater costs rule out the use of only one feed pump today; two pumps in series with closed heaters between will be necessary

Part-load operation requires careful analysis if reasonable efficiencies are to be obtained throughout the load range of the plant

DRIVES:

Motor-driven pumps with stepup gears will be popular in the immediate future. But steam and gas turbines, and possibly variable-frequency variable-speed squirrel-cage motors, may some day seriously challenge the geared motor drives

Variable-speed operation saves power, eliminates feedwater regulator, reduces pump wear at part loads and cuts pressure on discharge piping

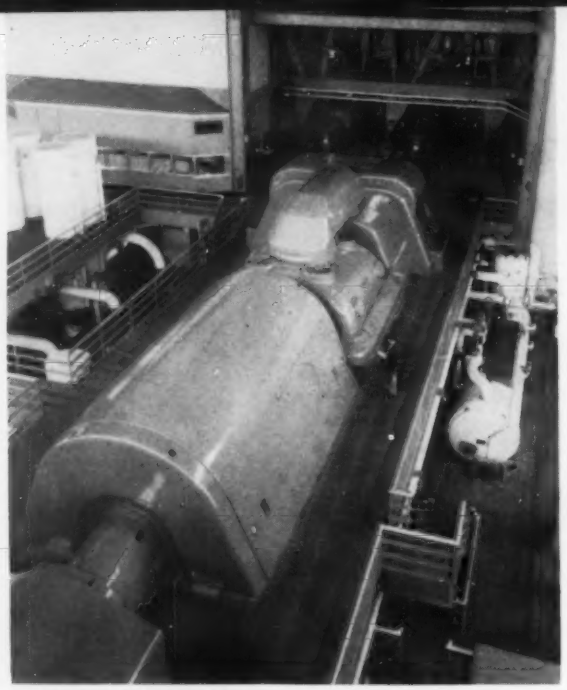
Two hookups for pump drive are feasible. First has a single motor with a double-extended shaft to drive both primary and secondary pumps. Second has a separate motor to drive each pump

CYCLES:

Mix-temp cycle (or re-entry cycle) may introduce some undesirable complications in superpressure plants if it is not carefully planned

Minimum economical capacity for a 4500-psi plant appears to be at least 250,000 kw. At 6000 psi, minimum size for economical operation is about 400,000 kw. As pressure rises, so does the minimum economical capacity

Base loading, though feasible during initial years of plant life, cannot be expected for the entire life. So some thought must be given the possibility of load swings, and their effect on plant operation



OPERATING TURBINE OIL life expectancy is influenced by oil-conditioning practice, contamination rate, and makeup rate

I: Effect of makeup rate on turbine oil life in lab test

Weekly make-up rate, %	No. of weeks	Total makeup, %	Oil life, hr*	Hours service per unit oil chg
0	0	0	1000	1000
3.3	7	23	1300	1060
6.7	12	80	2130	1180
10.0	21	210	3600	1160
15.0	19	285	3900†	1120††
20.0	19	380	4350†	840††

*Time required to reach a neutralization value of 2.0
†Makeup discontinued after 19 weeks (3192 hr). Tests then allowed to run to completion. Figures shown represent oil's ultimate life
††Calculated figure based on indefinite operation at designed makeup rate

II: Effect of makeup in hypothetical turbine operation

Life in years, zero makeup	Value for k, equation (4)	Makeup rate, % at which oil lasts indefinitely*	Years service per unit oil chg†
5	0.8	16	6.25
10	0.8	8	12.5
10	0.9	9	11.1
10	1.0	10	10.0
10	1.1	11	9.1
10	1.2	12	8.3

*Calculated annual limiting makeup rate at which oil lasts indefinitely
†Years service per unit charge of oil at limiting makeup rate

How does the makeup rate affect life span

Annual turbine-oil makeup runs between 7 and 12% of the total system capacity. To find how rates affect oil life, varying makeup rates were used in lab stability test. Result: A 6.7% weekly makeup is needed to double oil life in lab test setup

► MODERN INHIBITED steam-turbine oils last for several years under normal conditions. And it is not uncommon today to find turbines operating with oil that has been in the system 10 years or more. However, correlating the potential service life of a new oil with laboratory oxidation tests, like the ASTM Turbine-Oil Stability Test (D 943), is quite difficult. Reason: Service life of the oil is normally long and, in addition, service conditions, such as temperature, metal catalysis and contamination, vary widely.

Effect of each service condition mentioned above is fairly well understood today (*Ed. Note:* see POWER, March 1954, pp 94-95). But there is one factor, rate of makeup, that apparently has received little study. The D-943 test is normally run without any makeup. Actual turbine systems, however, seldom operate without some oil loss. Oil lost is periodically replaced with fresh makeup oil. Annual turbine-oil makeup rate usually runs between 7 and 12% of total oil in the system (*Electrical World*, Jan 12, 1953, p 75).

Test procedure. In our test setup we followed the D-943 procedure with one exception. A definite volume of oil was pipetted weekly from the sample tube and replaced with an equal volume of fresh oil. Weekly makeup rate was varied from zero to 20%. We used a commercial 150-grade turbine oil having a D-943 life of 1000 hr. This particular oil sample was chosen because its relatively short life gives results in a shorter test period. Results we obtained are shown in Table I.

This table shows how makeup rate exerts a sizable influence on oil life. For example, weekly 6.7% makeup more than doubles life, even though total makeup is only 80%. Effect of makeup on oil life is shown in Fig. 1. Percent increase in oil life is plotted against percent total makeup, Fig. 2. Note the relationship is nearly linear in the latter plot.

Calculating life. Since the relationship plotted in Fig. 2 is almost linear, a straight-line characteristic was assumed in calculating the percent increase in oil life due to makeup. Here are symbols used in the calculations:

Z: actual oil life with makeup

Z_o: oil life at zero makeup

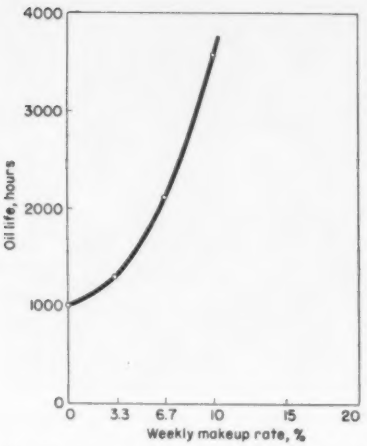
r: makeup rate expressed as percent of original charge, per unit time

x: total makeup expressed as percent of the original charge

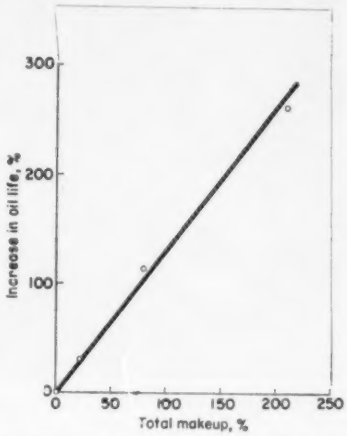
y: percent increase in oil life

Keep in mind the time units in Z, Z_0 and r must be the same. For exam-

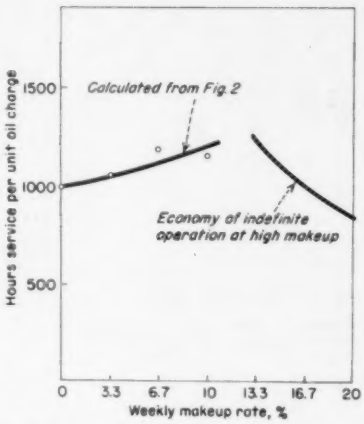
These curves illustrate effect on life in ASTM Turbine-Oil Stability Test under varying makeup rates



1 Commercial 150-grade turbine oil with D-943 life of 1000 hr, used in test



2 Effect of the total makeup on oil life is almost a straight-line relationship



3 At weekly makeup of 13.3%, this oil will last indefinitely in the ASTM test

# of your turbine oil?

By H H ZUIDEMA, *Research Laboratories, Shell Oil Company*

ple, if Z_o is in weeks, Z must be in weeks and r in percent per week. The following two equations become apparent after referring to Fig. 2:

$$Z = Z_o\ (1 + y/100) \qquad (1)$$

$$r = x/Z \qquad (2)$$

If the value of Z in equation (1) is substituted in equation (2), you get:

$$r = \frac{x}{Z_o\ (1 + y/100)} \text{ or}$$

$$x = rZ_o\ (1 + y/100) \qquad (3)$$

From Fig. 2, $x = ky$, where k is a constant. Therefore,

$$ky = rZ_o\ (1 + y/100) \qquad (4)$$

$$100\ ky = 100\ rZ_o\ (1 + y/100)$$

$$= 100\ rZ_o + Z_o\ y \qquad (5)$$

$$y = \frac{100\ rZ_o}{100k - rZ_o} \qquad (6)$$

Hence, in equation (6), the percent increase in oil life is expressed in terms of: the original life without makeup, rate of makeup, reciprocal of curve-slope relating percent increase in life to total makeup. Equation (6) will hold for any system where the relationship shown in Fig. 2 is a straight line. In the case we are discussing, Z_o is 1000 hours or six weeks and K is 0.8.

How to use. With a high makeup rate an oil lasts indefinitely. Equation (6) permits you to calculate the minimum, or limiting rate to allow indefinite life. Study equation (6) and note that y must approach infinity as quantity $100\ k - rZ_o$ approaches zero. This means the quantity rZ_o approaches $100\ k$.

Then since $k = 0.8$ and $Z_o = 6$ in the present case, the limiting value of r is $(0.8 \times 100) \div 6$, or 13.3% per week. And that means at makeup rates of 13.3% or greater, this particular oil would be expected to last indefinitely *in the ASTM D-943 test.*

An important consideration dollar-wise, is the length of service per unit quantity of oil. The ratio, hours of service per unit charge of oil, has been calculated from Fig. 2 and is shown as a function of makeup rate in Fig. 3. Note that economy increases with increasing makeup rate over the range from zero to 10% per week. The maximum economy shows up with a makeup rate of 13.3% per week, the minimum rate for indefinite operation. At higher makeup rates the economy will fall off quite sharply.

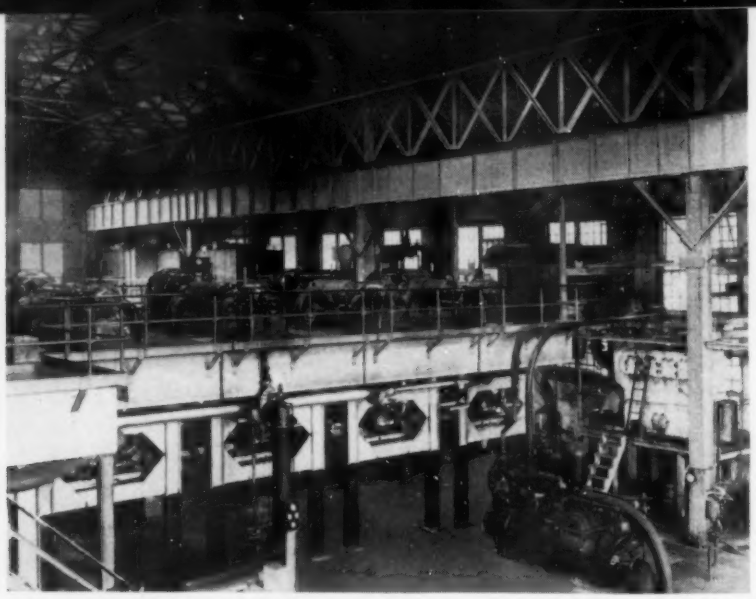
A word of caution. *There is no assurance that Fig. 2 will apply to actual turbines in plant operation.* However, if you assume that Fig. 2 is linear regardless of the value of k, then it is possible to calculate the limiting annual makeup rates for oils of assumed Z_o and k values. Calculations for a few such hypothetical cases were worked out and results are listed in Table II.

Note that service life per charge of oil increases with increasing makeup rate only when k is less than one. If k were appreciably less than one, with the normal makeup rate very low, it would be possible to reduce over-all oil needs by periodically removing a certain amount of oil from the system. In such a case, maximum oil removal would be the limiting makeup rate. Fresh oil replaces oil that has been removed.

Since the oil so removed from the system would still be in moderately good condition, it could probably be used in the plant in an application where oxidation is not a critical factor. However, if k is equal to or greater than one, any increase in makeup rate results in an increase in overall oil requirement.

There are no data available for determining the precise value of k. It appears that factors, such as vapor pressure of the oxidation inhibitor and action of the metal catalysts, could very well come into the picture.

By **E P MEIXSELL**, *Manager*
Compressor Department
Fuller Company



FOUR ROTARY COMPRESSORS on mezzanine at American Bridge are safe from floods

Rotary compressors give dependable

► THE COMPRESSED-AIR SYSTEM of the American Bridge Division, U.S. Steel Corp, Ambridge, Pa., serves a plant having an area of over 6 million sq ft. In this plant, compressed air is a vital utility in fabricating structural steel into sections for bridges, office buildings, factories, barges, transmission towers and other large structures.

This system supplies operating power for riveting, chipping and grinding equipment, forging hammers and general units like air clutches and air-operated clamping devices. Without compressed air, the plant would shut down quickly.

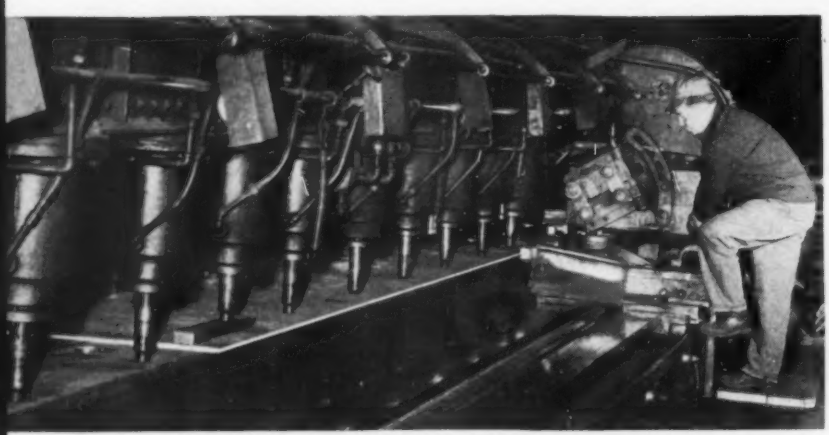
Compressors. To supply this air, four Fuller 2-stage rotary compressors are mounted on a 16-ft-high mezzanine. This scheme saves space and provides insurance against possible floods.

Each compressor is driven by a 350-hp 0.8-pf synchronous motor and has a capacity of 1660-cfm free air when discharging at 105 psig. Total capacity of the four units is 6640 cfm.

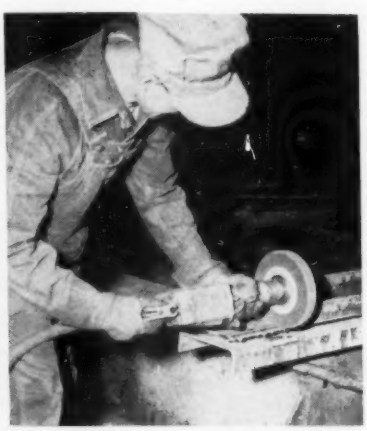
Hookup. Each compressor intake is fitted with an individual oil-bath filter; all filters are enclosed in a small room on the outside wall of the power house. The wall is fitted with louvers to permit outside air, instead of plant air, to be drawn into the filters. Filters are cleaned every week to insure a supply of dust-free air.

First stage compresses air to about 30 psi. The air then flows through an intercooler where its temperature is reduced from about 250 to 90 F. In the

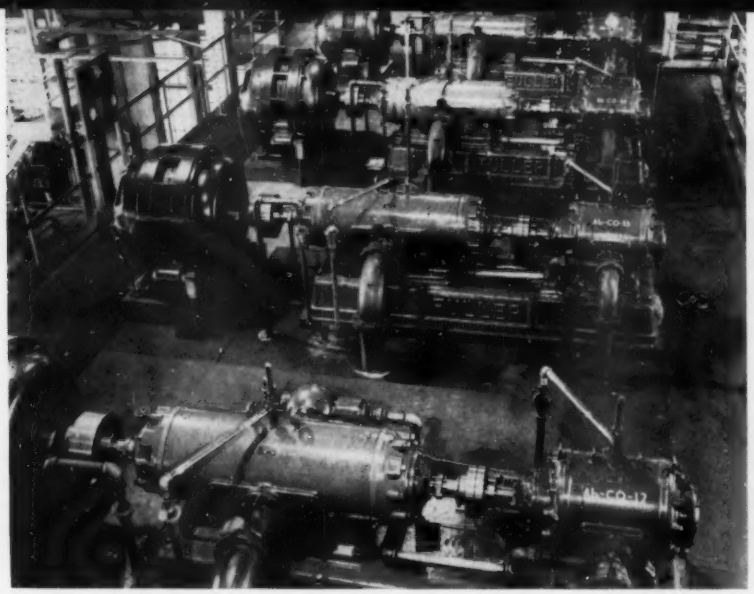
Here are four typical important uses for compressed air



COMPRESSED-AIR operated clamps hold steel plate for planing operation in mill



PNEUMATIC grinder smooths steel flange



2-STAGE COMPRESSORS are each rated at 1660 cfm at 105-psig discharge pressure

air supply at low cost

second stage, air is compressed to the 105-psig discharge pressure.

Intercoolers are suspended below the floor under each compressor. A separate water connection for compressor and intercooler gives individual flow through each, instead of series flow.

All compressors discharge to a common main, which delivers air to a single aftercooler and oil-and-water separator prior to distribution throughout the plant. Aftercooler reduces air temperature from about 300 to 70 F.

Two of the compressors are arranged to supply air to an independent auxiliary line serving four forge hammers. This line has its own aftercooler and separator.

A 12-in. main distributes air to the north and south ends of the plant. Piping system is designed to provide sufficient receiver capacity for the air demands of this part of the plant.

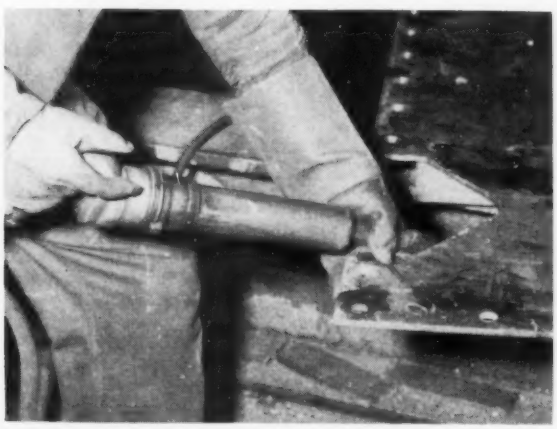
But air demand of forging hammers requires that a 428-cu-ft receiver be used. One 4500-lb hammer has a cylinder 18 in. in diameter with a 48-in. stroke. This hammer, which formerly used steam, is now pneumatically driven.

Over a 24-hr 3-shift period the plant requires about 3.5 million cu ft of air. Since addition of the hammer load, all four compressors are needed to supply plant air demand. Three run continuously; the fourth is automatically regulated by its unloader to cut out once 105 psig is reached in the system. For a 2-year period, all compressors ran 24 hr per day, seven days a week.

Except for periodic cleaning and lubrication, the only maintenance required for these units is occasional replacement of bearings. Worn blades are replaced about every four years.

Freedom from vibration during operation permits use of light foundations for rotary compressors. Installed on the mezzanine at American Bridge, they save much space on the main floor. While initial efficiency is a little lower than with other machines, the inherent ability of the rotary to maintain its rated output, coupled with lower installation and maintenance costs, more than compensates for this factor. Test equipment at this plant permits fast checks of the output of each compressor.

in the manufacture and fabrication of structural steel

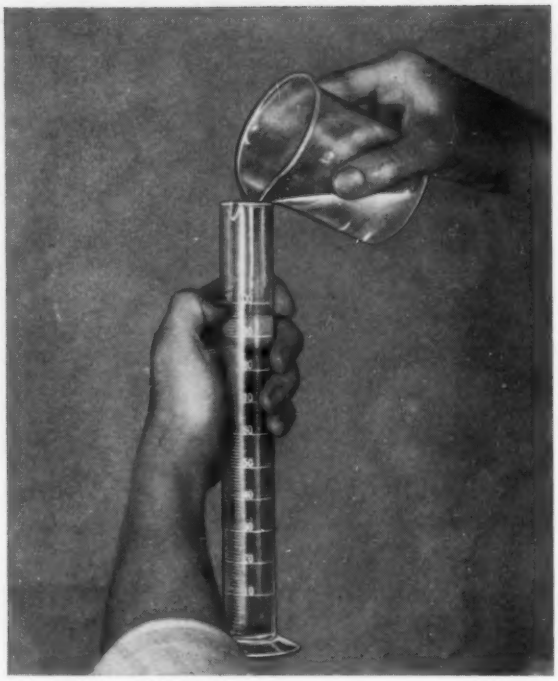


CHIPPING HAMMER, air-operated, readies metal plate for weld

PNEUMATIC RIVETER finds much use working structural steel

STEP 1: Adding acid

Clean evaporating dish or casserole thoroughly and rinse with boiler water to be tested. Put approximately 10 drops of concentrated hydrochloric into the evaporating dish



STEP 2: Getting sample

Clean a graduate and rinse it with boiler water to be tested. Water should have minimum exposure to air, be cooled, unfiltered. Measure out 100 ml of boiler-water sample in graduate

New additive eases the testing for excess sulfite

By Dr W D TURNER
Chief Consultant
Magnus Chemical Co

► FOR MANY YEARS the chemical analyst has had to train his eye to recognize the difficult-to-see endpoint of iodine titration in checking excess sulfite in boiler water. The solution turns brown when the endpoint has been reached, and the appearance or disappearance of this color is hard to detect.

To get around this, starch has been used to change the brown into blue. The blue color is more intense than the brown, and the average eye is more sensitive to the blue. For this reason, starch is commonly added to the boiler-water sample.

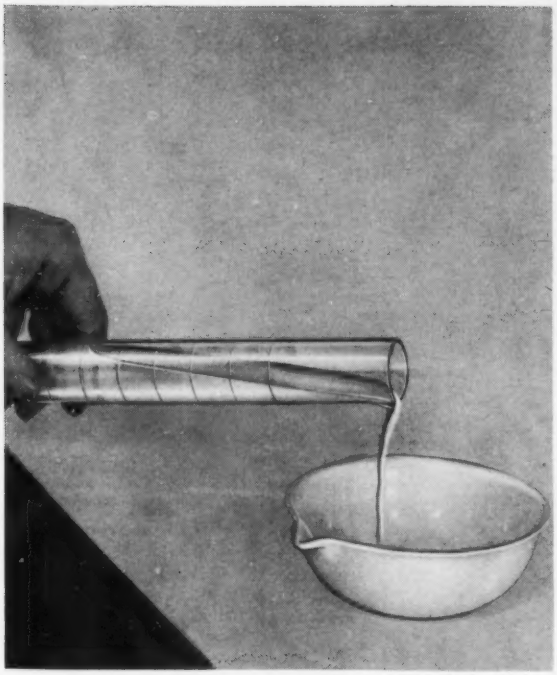
However, starch has certain disadvantages. First, it must be made soluble in water. This requires cooking. Then, it must be preserved by using an effective bactericide, moldicide and antifermentive.

These preservatives must not interfere with appearance of the endpoint. The starch must be handled in liquid form. Finally, the starch gradually deteriorates with time. For this reason it is not usually supplied ready for use by chemical supply houses. For best results with starch, a new batch should be made at least every three days, preferably every day.

There has now appeared on the market an indicator that gives the advantage of the sharp, blue, sensitive endpoint without any of the above disadvantages. It is a dry, white organic substance, and is permanently stable. A few tenths of a gram of the new indicator added to an iodine titration serves as well as a milliliter of the starch solution, and it is instantly soluble in as little as two times its weight of water.

The new indicator, Thiodene, requires no preparation of any kind. It can be handled on the tip of a spatula or be directly shaken from the bottle as it is a free-flowing powder. It was developed and for some months has been marketed in England, and has now appeared on the American market.

Tests of the compound show that it gives exactly the same endpoint as starch in all the types of titration where starch is indicated. The quantity is not at all critical and results are equally satisfactory over at least a fivefold range.



STEP 3: Adding sample

Add the 100-ml boiler-water sample to the evaporating dish. (If titration were done now, endpoint would be indicated by appearance of a brown color. This endpoint is hard to see)

STEP 4: Adding Thiodene

Add a very small pinch of the stable Thiodene powder to the boiler water sample and stir. Thiodene gives clear titration endpoint, and has many advantages over starch additive

in boiler water

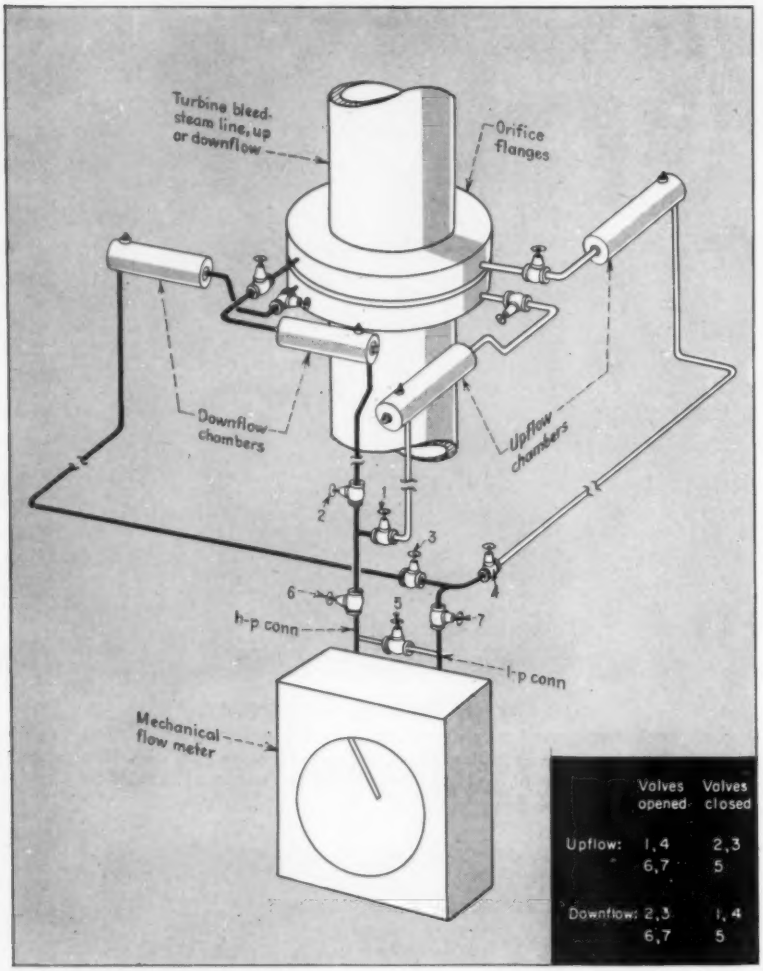
Sulfite

Under proper conditions sodium sulfite reacts with and removes dissolved oxygen from boiler water. However, the use of this chemical as a deaerant is economical only within certain limits of dissolved oxygen content.

Safest practice is to remove as much of the oxygen as possible by mechanical means and then maintain a small sodium sulfite residual in the boiler water that will react with and remove the remaining oxygen contamination.

STEP 5: Titration

Stir while titrating with standard potassium iodide-iodate solution (1 ml = 0.5 mg SO_3). Stop when permanent blue color develops throughout. Reading times five is ppm sulfite as SO_3



HOOKUP DRAWING shows arrangement of valves for steam flow in either direction. Shutoff valves at orifice are always in open position while meter is in operation

Wide variation in steam and electric load dictated turbine operation on an extraction or mixed-pressure cycle. This meant metering 200-psi steam to or from the extraction stage. Here's how the job was done with a . . .

Two-way flowmeter

By J J **BRESNAHAN**, *Chief Engineer*
City of Holyoke Gas & Electric Dept, Holyoke, Massachusetts

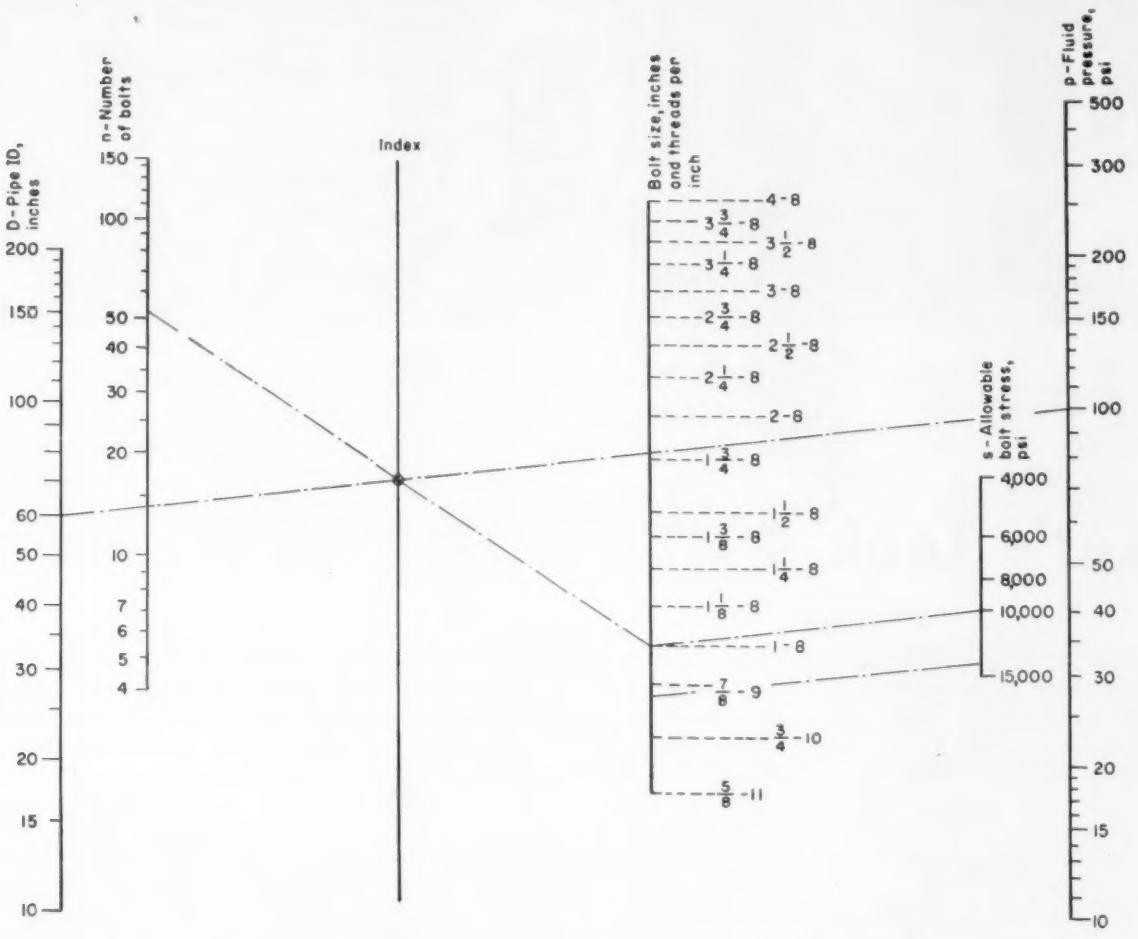
► GEARED TO SUPPLY electrical power and steam to industrial and domestic consumers in Holyoke, the city's newest turbine installation must operate over an unusually wide range of loads. Power users include paper and textile mills, both requiring large amounts of heating and process steam.

Turbine flexibility. As a service to existing industries and as an inducement to new industries this turbine-generator is designed to run as (1) a straight condensing unit (2) an extraction unit (3) a mixed-pressure unit (4) a combination incorporating any of these characteristics depending on the extraction-steam load demand. Under this setup the extraction stage either supplies or receives steam from a 200-psi header. With ample high-pressure steam on hand, the extraction line feeds steam to the header. When excess low-pressure steam is available and electrical load is light, the turbine operates by inducting steam from the header—reversing flow in the extraction line.

Economical metering of 200-psi steam flow in either direction is handled with only one flowmeter. The instrument-piping hookup drawing, *at left*, shows how this is done. For downflow: valves one, four and five are closed, while valves two, three, six and seven are opened. For upflow: valves two, three and five are closed, while one, four, six and seven are opened. Shutoff valves at the orifice remain open except when the system is dismantled for maintenance purposes. Condensing chambers operate in pairs to provide equal static head to high-pressure and low-pressure meter connections.

Notice that whether steam flow is up or down, the high-pressure side of the meter body is connected upstream with respect to flow. Similarly, the low-pressure side is connected downstream of the flow at all times.

Proper functioning of this meter requires that operators be alert to switch instrument valving to its correct position when steam flow is reversed.



Flange-bolting chart for large-size pipes

► WHILE FLANGES for steam and water service are standardized for the smaller sizes, designers must often figure the dimensions and bolting for medium- and large-size flanges. Also, if the pressure of an existing system is to be boosted, a check should be made on the adequacy of the flange bolting. This chart serves as a handy tool for getting quick answers to such problems.

The formula from which the chart was developed simply states: Force exerted by the fluid on the pipe internal area is equal to the resisting force developed by the flange bolting. Or, expressed in mathematical terms:

$$p \times \frac{\pi D^2}{4} = s \times \frac{\pi d^2 n}{4}$$

where

p = Fluid internal pressure, psi
D = Pipe ID, inches
s = Allowable bolt stress, psi
d = Bolt root diameter, inches
n = Number of bolts

This is valid where conventional gaskets not needing preloading are used.

Example: $p = 100$ psi, $D = 60$ inches

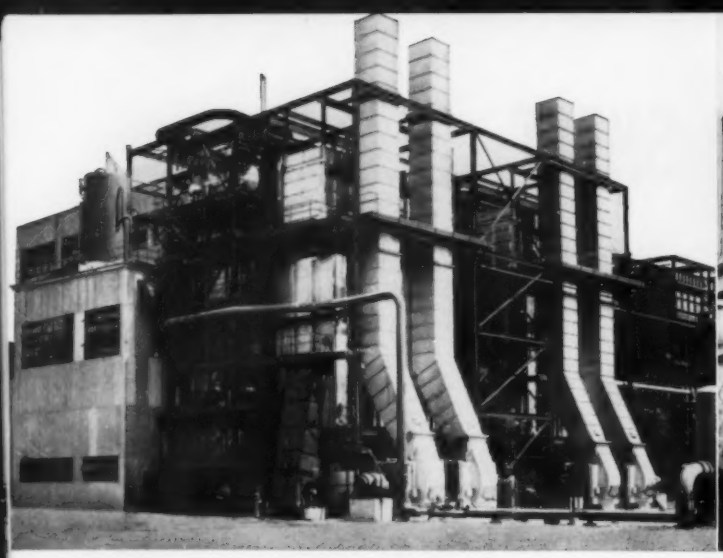
Solution: Draw a line between 60 on the D scale and 100 on the p scale and mark the intersection of this line with the index line. Choose the desired number of bolts (52 in this case) and connect this figure on the n scale with the scale for bolt sizes by passing through the first mark on the index line. The bolt size will be one inch, with eight threads per inch. This chart is prepared for an allowable bolt stress of 10,000 psi. If high-grade bolting is used with an allowable stress of 14,000 psi, connect the 1-8 point on the bolt-size scale with 10,000 psi on the s scale. Then draw a line parallel to this one through 14,000 psi on the s scale. The new bolt size will be ⅞ of an inch, with nine threads per inch.

BY HANS W HAMM, *York, Pa.*

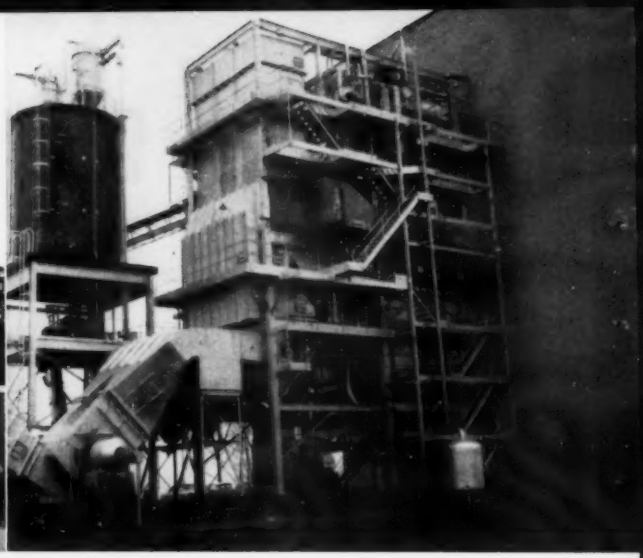
Correction

In Data Sheet No. 262, April 1954 POWER, p 107, a zero was accidentally dropped from the formula in lower right corner. Correct 18,00 to read 18,000.

© POWER



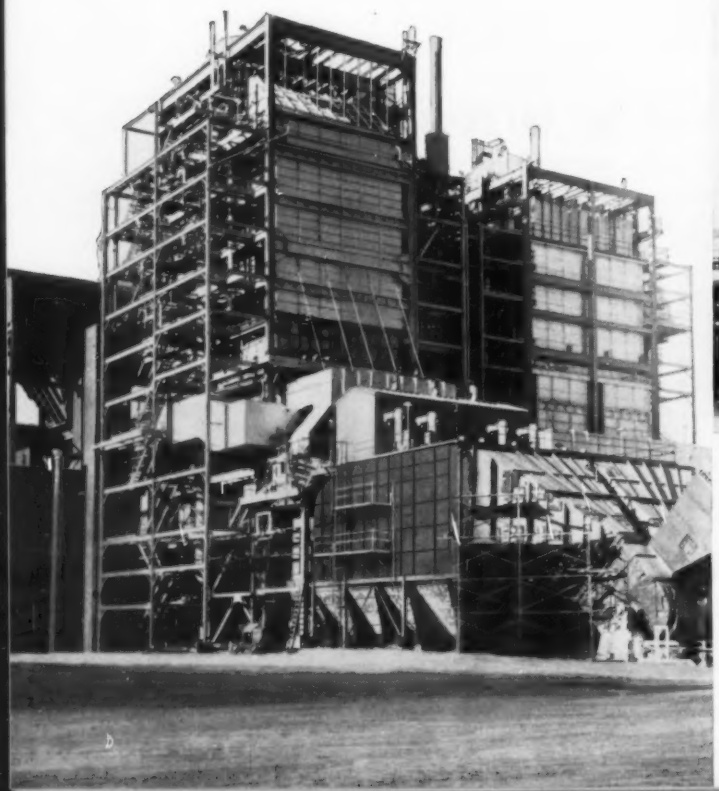
Two of ten 450,000 lbs./hr. outdoor steam generating units that were recently installed by Riley at Dow Chemical Co., Freeport, Texas. Design Pressure 1450, steam temp. 950°F. Fuel—Natural Gas; Efficiency 81.9%. Stone & Webster, Engineering Corp.

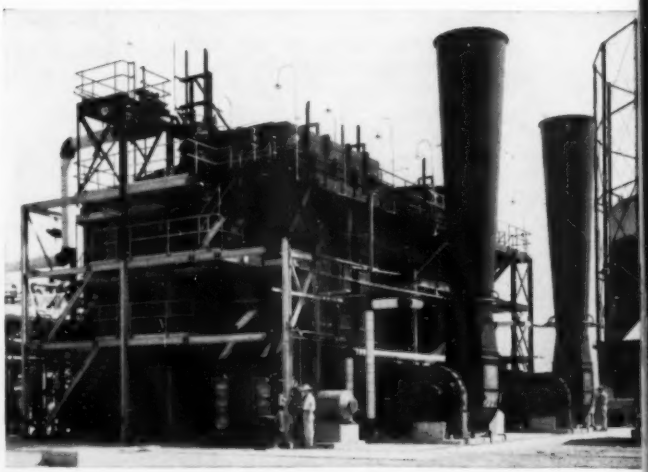


Moniteau Plant at Chamois, Mo. of the Central Electric Power Co-op. has most of its Riley boiler outdoors. Capacity 160,000 lbs./hr. Design pressure 975 psig. Temperature 900°F. Kuljian Corporation, Consultants.

Let's Look OUTDOORS at RILEY

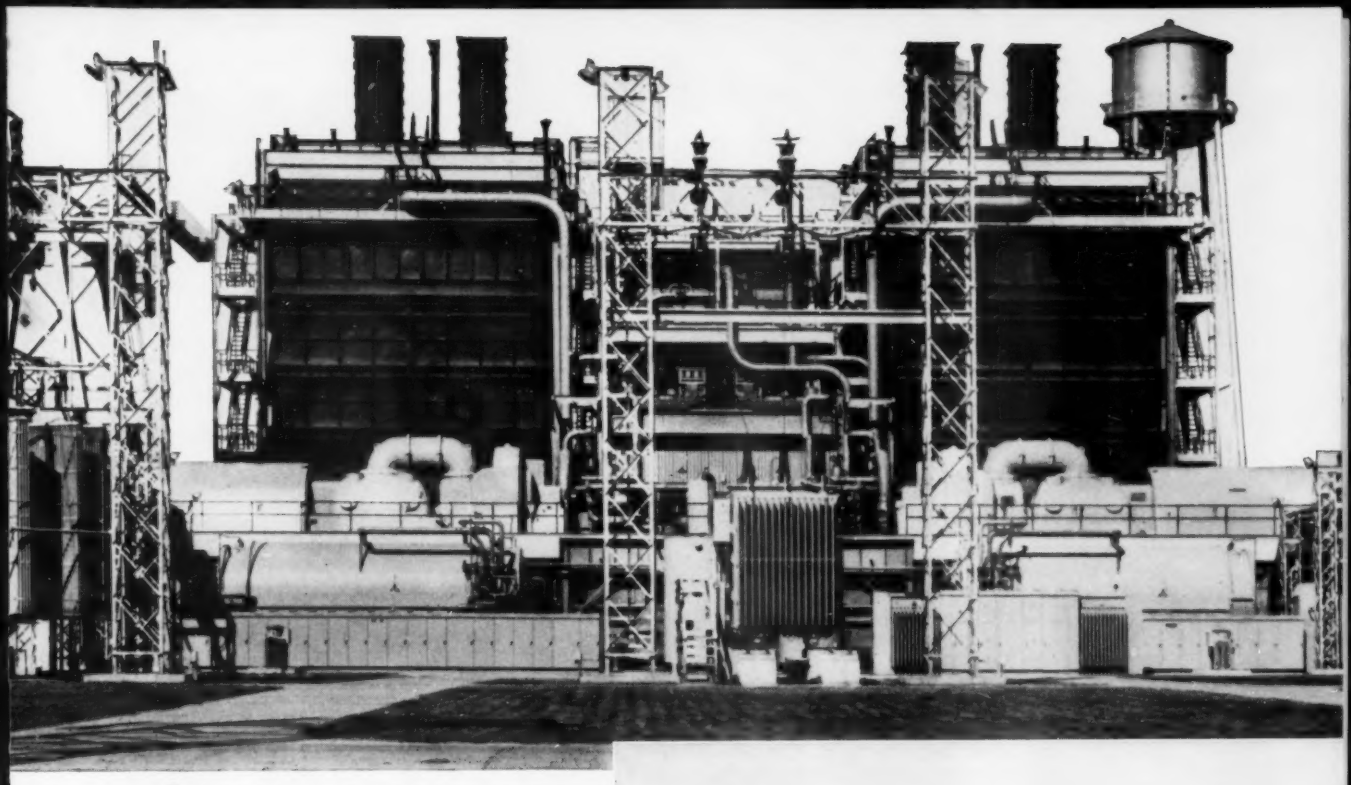
When you are specifying new steam generating equipment it may pay you to consider installing a Riley outdoor or semi-outdoor unit. Many industrial and public utility companies have affected considerable savings by installing Riley units either completely outdoors or just partially enclosed. Your Riley sales engineer or Consulting Engineer will advise you whether an outdoor or a semi-outdoor Riley steam generating unit is practical for your requirements.



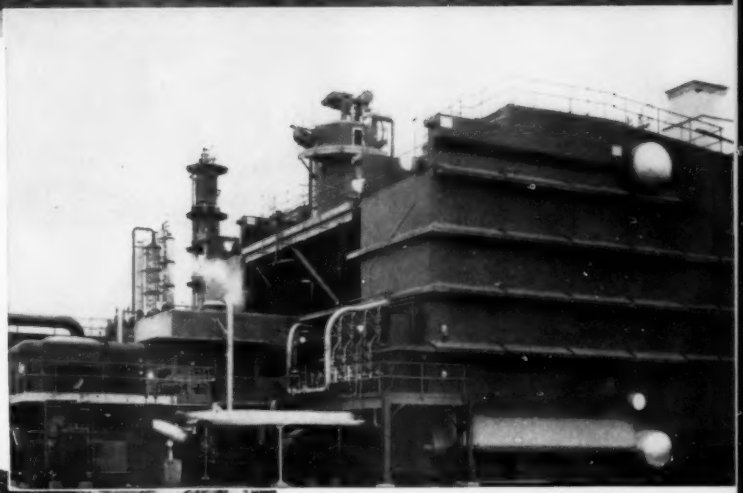


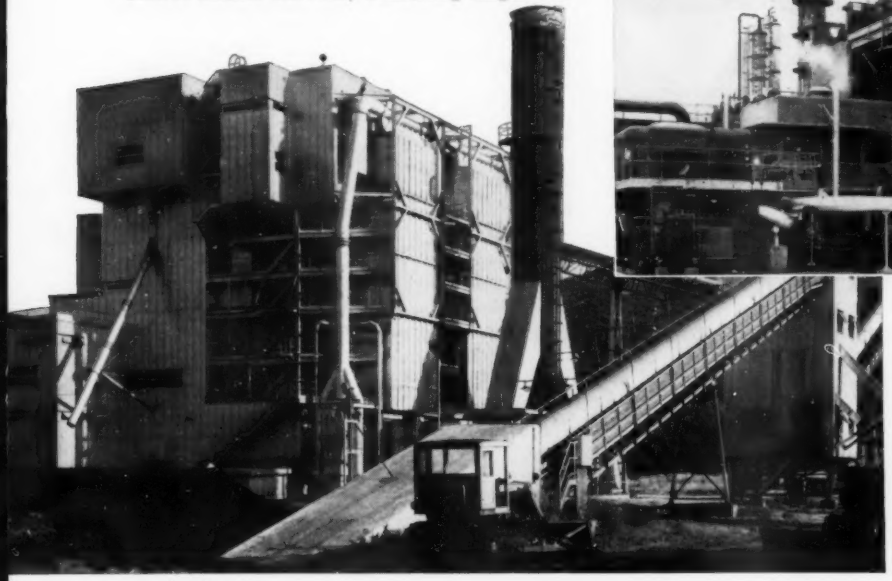
Two completely outdoor Riley steam generating units are part of recent expansion program of Commercial Solvents Corporation at Sterlington, Louisiana. Capacity 125,000 lbs./hr. 675 lb. design pressure, 735° Fahrenheit. Ford, Bacon & Davis, Consultants.

Utah Power & Light Company's new Gadsby Plant has two Riley outdoor type high pressure steam generating units. Unit #1 620,000 lbs./hr. 1510 psig, 950F. Unit #2 575,000 lbs./hr., 1525 psig, 1005F. high pressure and reheat steam temperature. Bechtel Corporation, Consulting Engineers.



Two completely outdoor Riley steam generating units each with 675,000 lbs./hr. capacity at Houston Lighting & Power Company's Green's Bayou Station are two of eleven Riley units purchased by this public utility. One Riley 1,200,000 lbs./hr. outdoor reheat unit is now under construction and another will soon follow. Ebasco Services, Consulting Engineers.





One of two all-outdoor 200,000 lbs./hr. Riley boilers with pressurized furnaces installed by Riley for a large Chemical Co. Steam pressure 900 psig, temperature 875°F. Fired by natural gas. Ebasco Services, Engineers.

Prominent are the air preheater casings of two 210,000 lbs./hr. Riley boilers of West Penn Power Company's Milesburg, Pa. Station. Operating steam pressure 850, Temperature 900F. Sanderson and Porter, Engineers.

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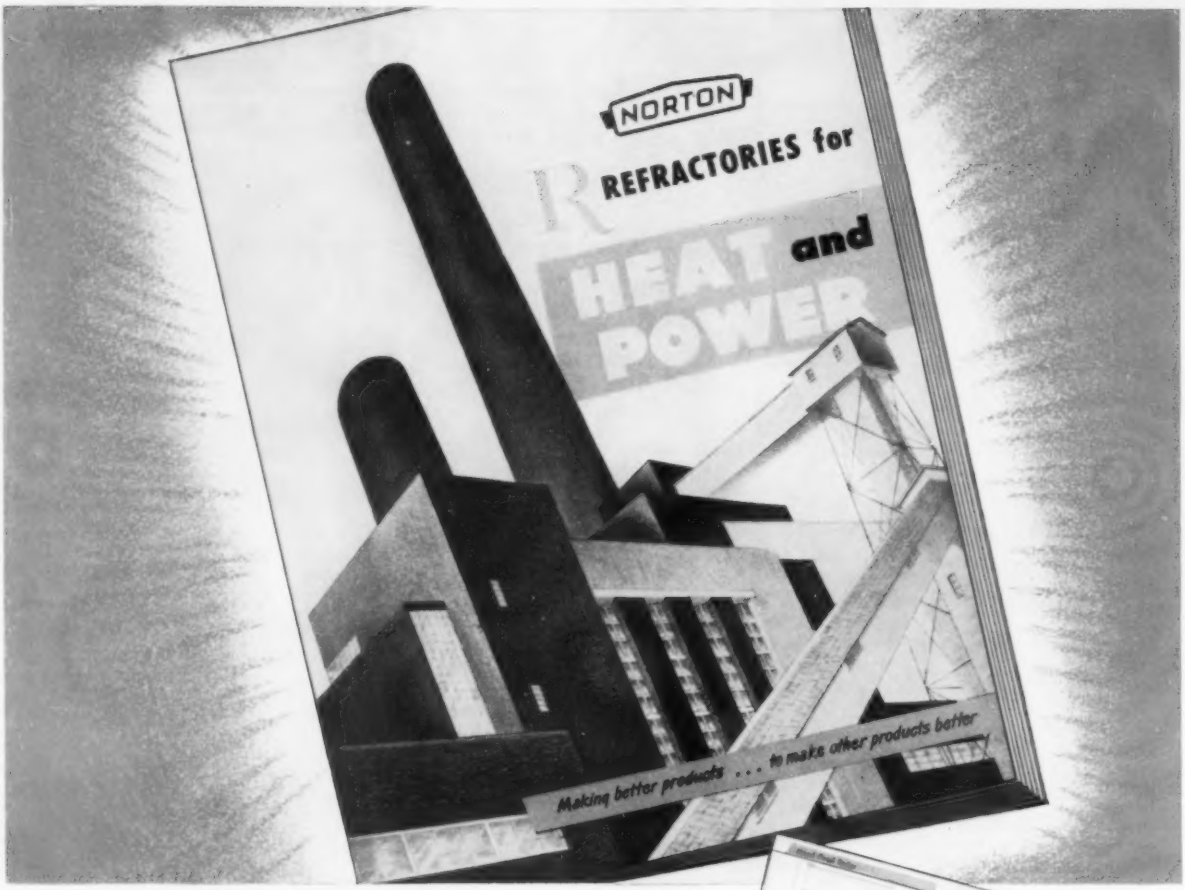

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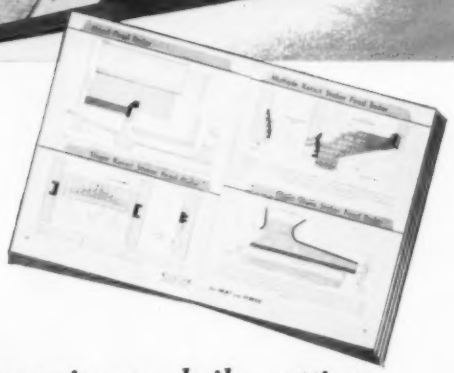

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REPAIR-WELDING large cast-iron gate-valve bonnet is done while the oil burner used for preheating keeps casting hot. Preheating is very important part of job

'You can repair-weld cast iron,'

says the American Welding Society, 'but you must preheat, use right methods and rod, then have topnotch welder do job'

► CAST-IRON defects, such as misruns, cold shuts, laps, blowholes, cracks, porosity, broken-off portions, mismachined dimensions, tool gouges, etc, can be repair welded.

Getting ready. First, open the cavity, crack, or other defects, and remove foreign material like sand. Do this either by oxyacetylene gouging, arc gouging, chipping, grinding or drilling, depending on job, but grinding is best.

Gouging with usual oxyacetylene equipment is slow and the cut surface is rough and uneven because graphite flakes protect cast-iron surface. Also, oxygen stream is diluted by carbon dioxide during oxidation while cutting. Then slag crusts form on surface, protecting metal beneath from oxidation just enough to prevent cutting. Gouge by using iron powder.

Three arc-gouging methods for cast iron are: (1) metal-arc using electrodes with special flux coating (2) metal-arc using flux-coated, hollow electrodes through which oxygen is directed at area heated by arc (3) carbon-arc using graphite electrodes. Arc-gouging is faster than oxyacetylene gouging, but takes an excellent mechanic.

For fast, smooth gouging, use oxyacetylene torch that introduces an iron powder (or add an iron powder) into cutting oxygen stream. Iron powder gives additional heat from combustion of powder and from fluxing action.

Preheat for either oxygen powder or arc-gouging process where (1) a soft oxygen-cut edge is needed and (2) high thermal stresses might develop from size and contour of area or from shape of casing. Where you can't preheat weld immediately by oxyacetylene, arc gouging may be best because heat input is less and more localized.

Effect of welding. Cast iron has low ductility and high carbon content. You must know this before welding. In common with all ferrous materials, if one section of a casting is heated to welding temperature, it expands. This causes no trouble if design permits free expansion. But if design is rigid, cooler sections may be stressed until metal fractures.

Once you understand danger of breaking, you can take steps to prevent it. Best insurance is preheating entire casting to a moderate temperature, or locally preheating sections subject to high stresses.

Remember (1) gray cast iron has high carbon content (2) greater portion of total carbon should be present as graphite flakes in finished weld and adjacent base metal also influence welding operations. Graphite flakes give gray-iron valuable properties—excellent machinability. If iron of high carbon content is cooled rapidly from molten state, carbon

Based on pamphlet, "Repair Welding of Cast Iron Pipe, Valves and Fittings," by American Welding Society, 33 West 39th St. New York 18, N. Y. Photos, courtesy Air Reduction Sales Company, International Nickel Company, and Consolidated Edison Company of New York.

1 Grind edges of U to remove scale, rust, paint, after gouging out crack

2 Wire-brush after grinding to remove loose metal, chips etc, for good job

3 Preheat with oxyacetylene to about 150 F to remove chill from the casting

Here are the preheating temperatures, the various kinds of electrodes to

doesn't have time to separate out in form of graphite flakes, but is largely or entirely retained as iron carbide, cementite. That makes it brittle and almost unmachinable. That's why molten or base metal next to weld must cool slowly.

Two solutions are to preheat or postheat. Preheat either entire casting or localize zone next to weld. Then mass of metal around weld won't remove welding heat so fast. Postheating, always followed by slow cooling, relieves any residual stresses from welding operation.

REPAIR-WELDING METHODS

Oxyacetylene with gray-iron rods insures deposit of same color, composition and structure as base metal. If weld is made right, joint is as strong as original casting. Here, process is important.

First V the castings to 60- to 90-deg angle. Don't extend V completely through casting or sections to be assembled because you'll have trouble aligning and may melt entire section.

Preheat casting either entirely or locally in critical sections if it's closed or rigid. It's best to preheat entire casting to 800-1050 F, or as high as 1250 F if casting is alloy. Heat not only equalizes expansion and contraction stresses, and insures machinability of final weld, but also helps do a quicker job and saves labor and gas. Charcoal fire or furnace is best. Torch preheating is OK for small castings or noncritical parts of large castings.

Rod for welding cast iron should have composition high in carbon and silicon, as a portion of these two elements is lost in welding. Two recommended rod compositions are:

Element	*No. 1*	*No. 2*
Carbon	3.20-3.70	3.20-3.70
Silicon	2.75-3.50	2.75-3.50
Phosphorus	0.50-0.75	0.55 max
Sulfur	0.50-0.75	0.50-0.75
Manganese	0.12 max	0.12 max

Use No. 1 where more fluid filler metal is needed. No. 2 is good for build-ups.

Use alloy rod if alloy iron is welded, or if a very strong, dense weld is needed. These rods contain chromium, nickel, molybdenum, copper or vanadium, either singly or in combination. Two typical compositions of high-strength rods are:

Element	*No. 1*	*Element*	*No. 2*
Carbon	3.30 max	Carbon	2.90-3.20
Silicon	2.75 max	Silicon	2.75-3.25
Manganese	0.50-0.75	Manganese	0.70-0.90
Sulfur	0.10 max	Sulfur	0.10 max
Phosphorus	0.25 max	Phosphorus	0.30 max
Chromium	0.25-0.60	Vanadium	0.15-0.25
Nickel	1.50 min		
Molybdenum	0.25-0.60		

Neutral flame is preferred to gas-weld cast-iron, but some experts recommend slight excess of acetylene at times where carbon burn-out is a problem. Use high-velocity welding tip with a concentrated flame pattern.

Always use flux to increase fluidity of iron-silicate slag that forms on molten puddle.

After V has been prepared and casting preheated, direct torch over surface 1 in. around weld until entire area is dull red. Then play flame at bottom of V, keeping tip of cone ⅛ to ¼ in. from metal, until a 1-in. molten puddle forms.

Move flame gradually from side to side until edges of V begin to melt down into puddle. Next, heat tip of rod in flame and dip into flux. Introduce rod into puddle and direct flame on rod, thus adding filler metal to puddle. Melt sides of V ahead of advancing puddle to not over ⅜-in. depth.

For rigid structures needing extensive machining, stress-relieve at preheat temperature after welding. But allow casting to cool slowly by furnace cooling, covering with asbestos or burying in sand.

Oxyacetylene braze welding. Bronze filler rod with oxy-

4 Use 120 to 130 amp for a 5/32-in. nickel-base rod with reverse polarity

5 Arc-welding this size cut takes about 8 or 9 beads to do the job properly

6 Peen lightly with a round-nose tool after each bead to remove slag, stress

use and all the other information you need for repair-welding cast iron

acetylene torch has advantages if weldments aren't subject to electrolytic corrosion or high-temperature service. Because of lower preheat, large castings can be braze-welded in position.

Badly oil-soaked or oxidized castings should not be welded. Cleaning must be more thorough for braze welding than for other methods. Tensile strength of braze welds decreases above 500 F so don't use for high-temperature service. Bronze-weld metal also reacts with some chemicals, contaminating fluid being carried. Or joint is subject to electrolytic corrosion.

Filler metal for braze welding is basically 60% copper, 40% zinc, with various additives. Tin of 0.50 to 0.70% is usually added. Silicon of 0.10% cuts down fuming. Small amount of manganese speeds tinning and increases strength. Brazing fluxes are always used.

Scarf or V same as for welding with gray-iron filler. Thoroughly clean surfaces to be brazed, as free graphite on surfaces will prevent tinning. Degraphitize surfaces by searing with slightly oxidizing flame at 1600 F (red heat), sandblast or clean with oxidizing agent like potassium chlorate.

Preheating V alone may be OK but, if possible, preheat entire casting to 600-750 F or more.

Place casting so weld can be made in either flat or uphill position. Warm V and area with torch. Heat 3-in. area at beginning of weld to dull red color. Warm brazing rod in flame, dip in flux and melt onto surface of V. If base-metal temperature is right, filler metal will tin surfaces to be braze-welded. If the filler metal forms drops and tends to roll off, base metal is too cold. If it boils and forms into little balls, base metal is too hot. With right heat, see that tinning proceeds ahead of actual weld. After welding, allow casting to cool slowly.

Arc welding with nickel-base electrodes. Arc-welding cast iron with commercially pure nickel electrodes is widely used. Flux-coated pure-nickel electrodes are usually most successful. Others are flux-coated monel metal (70% Ni, 40% Cu), flux-coated copper-sheathed nickel and nickel-iron (60% Ni, 40% iron).

Such welds can usually be machined even without preheating. You can use in any welding position, though down hand is easier. But graphite in most flux coatings dissolves in nickel and then precipitates on cooling—weakens weld. Process is best for surface defects or joining thinner sections. You may have to preheat to 150-250 F if casting is below normal room temperature.

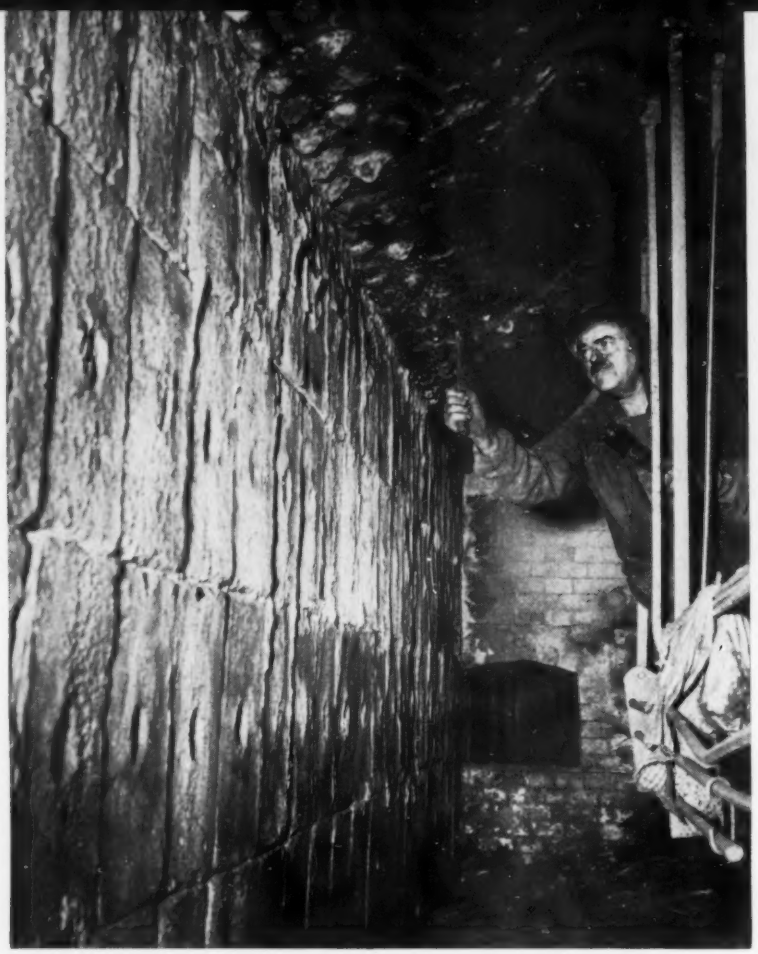
Arc welding with mild-steel electrodes: mostly for repairing small pits and cracks because a hard zone, or layer, at fusion zone forms between weld deposit and base metal. High stresses develop because shrinkage of steel is greater than of cast iron. Usually studs are used to key the weld to the unaffected base metal below the fusion zone. Preheat only to prevent excessive stresses in other parts of casting.

Arc with cast-iron electrodes: limited to repairing moderate-size castings. It's faster than oxyacetylene for small defects but results are not uniform. Preheat from 300 to 1400 F, depending on casting.

Arc with copper-base electrodes: used where preheating is impractical, machinability and color not important, or electrolytic corrosion no problem.

Inert-gas metal-arc welding (nonconsumable electrode method) is new. Arc is maintained between a tungsten electrode and base metal—filler metal is added into heat of arc with filler rod. Arc and molten pool are shielded from oxidation by stream of inert gas, either argon or helium, introduced through ports in tungsten electrode holder.

No flux is needed; weld has little or no slag covering; weld deposit tends to be free from porosity; weld metal is same composition as filler rod. These features make process promising to repair-weld cast iron. Preheat to 500-1050 F. Stress-relieve for machining by postheating to 1250 F; cool slowly. Handle these jobs carefully for best results.



BOILER INSPECTORS can't work as well when they're assigned to a poorly cleaned job like this. Worse yet, corrosion will be more severe than in a correctly cleaned unit

By **TYLER HICKS,** *Associate Editor*

Make this summer count next winter!

Overhaul your heating system now

► SUMMER IS HERE and most of us will forget our heating systems until next winter. Forgetting is easy—especially when the mercury stands somewhere between 80 and 90 F and the bright sun warms the countryside.

But does forgetting now pay dividends of better operation on those zero days in January? No, it doesn't and never will. So get out from under the shade of that elm, and take a close look-see at your heating system today.

System checks. One of the best places to start your summer overhaul is at the source of last winter's complaints. For example, if the foreman on the second floor bothered you all winter with complaints about drafts and lack of heat, now is the time to cure that trouble and stop next winter's complaints before they start.

Boilers. Overhaul in accordance with recommended procedures for your units. Check carefully how they should be laid up—wet or dry. If wet, be sure to fill completely so all air is excluded from interior. If dry, use a suitable material (quicklime) to absorb moisture. Close all manholes after putting quicklime on boards inside boiler.

Once your overhaul is finished, call in the boiler inspector. Be sure the fire and water sides of the boiler are clean and free of soot and scale. Wash out water legs with high-pressure water. Make a note of any troubles you want the inspector to check. Then when he calls, you won't forget them.

Greatest summer danger to heating boilers is corrosion of fire and water sides. That's why soot and scale removal and proper filling or drying out are so important. Take care to prevent corrosion now and next winter you'll be a happy man.

Piping. Start at the boiler and go over every foot of your piping system. Check pipe pitch, hangers, vents and traps. Correct any faulty pipe connections that gave you trouble last winter.

Replace damaged or missing pipe insulation. And while you're at it, try to find the cause of insulation damage. Sometimes careless operation of lift

trucks, poor storage of crated materials, or simple negligence during maintenance can lead to costly damage of insulation and piping. Caution maintenance men to use ladders instead of standing on that nice new insulation. Nothing can do quite so much harm as a sharp, dirty heel that cuts through a canvas jacket.

Radiators, convectors. Remove and test thermostatic trap elements. A trap that won't close wastes steam, can lead to complaints. Easiest way to check thermostatic elements is to install a trap body in a steam line hooked to the heating-system main. Connect a water line fitted with a needle valve to the pipe containing the trap body.

Turn on steam after filling body and line with water. Element should discharge water, then close when steam reaches it. Replace defective elements with new ones in good condition. See POWER, Nov '50, p 95, for a handy radiator-trap test stand.

Check dampers on convectors. Clean dust and dirt from convector outlets so warm air flows freely. The best convector is useless if its air flow is blocked.

Unit heaters. Get up on a ladder and inspect unit heaters from all angles. You miss a lot if you stand on the floor and take an upward gander.

Look over the steam supply and condensate-return connections. See that trap works right. Turn fan motor on and off several times; watch and listen as it runs. Clean fan blades, if they are dirty. Brush dust and dirt from heater coils. Look over heater control thermostat, if one is used. Inspect thermostat contacts. If a guard is used around thermostat to prevent resetting, see that it hasn't been tampered with. Leave each unit heater in spotless condition, ready to go when needed.

Centrifugal heaters. Check heater inlet to see that air flow is not obstructed by crates, vehicles or other equipment that has been left around. Follow air flow through the unit and check heater throw; it should overlap the throw of other units. If partitions or other semi-permanent structures have been erected near the heater, test air-distribution pattern. If it has been seriously obstructed, consider replacing the existing heater with wall or ceiling-mounted units.

Hot-water systems. Annual draining of a hot-water heating system may increase corrosion because the makeup may contain more oxygen and CO_2 than the existing water. In some large systems, chemical treatment or deaeration, or both, may be needed to prevent excessive corrosion.

Keep an eye open for leaks. A tight system has little or no air leakage. This reduces danger of corrosion from oxygen in the system.

Carefully inspect expansion tanks and circulating pumps. Defects in these parts can throw the heat supply of one or more zones out of kilter on the coldest day in the year when you have plenty of other things on your mind.

Vacuum systems. Test vacuum pumps to see that they pull the right vacuum for best operation. Overhaul faulty pumps immediately. Inspect pump start-stop controls for worn contacts, defective switches and blown fuses.

Spares. Summer is a good time to stock up on spare parts like traps, valves, vents, lengths of pipe, fittings, etc. You'll find the parts easier to obtain and you'll probably save some on the cost. Most supply houses offer summer price reductions to keep their winter products active all year round.

Fuel. Will you have enough fuel on hand come the first cold day next winter? Better check now. By buying a large quantity you can get a price advantage and you won't have to worry about delayed deliveries next fall. So check that fuel tank or coal pile today.

Follow the fuel flow from the tank or pile to the burners, stokers or grates. Check tank for sediment, water and leaks. If tank is empty, or nearly so, why not take this opportunity to clean it, inside and out? A clean tank insures better burner performance and relieves the fuel strainers of some dirt loading.

Remove and clean all fuel strainers. Then do the same for your oil burners. Check light-off system—gas or electric—to see it functions safely. Clean furnace interior, replacing damaged refractory. Remove all carbon accumulations from the furnace.

Stokers. Overhaul as the manufacturer recommends. Replace burned-out or damaged grate bars, chains and other parts. See that you have a good supply of shear pins on hand for next winter. Remove any coal left in hopper and inspect the metal walls and chutes for damage from corrosion, abrasion or shock.

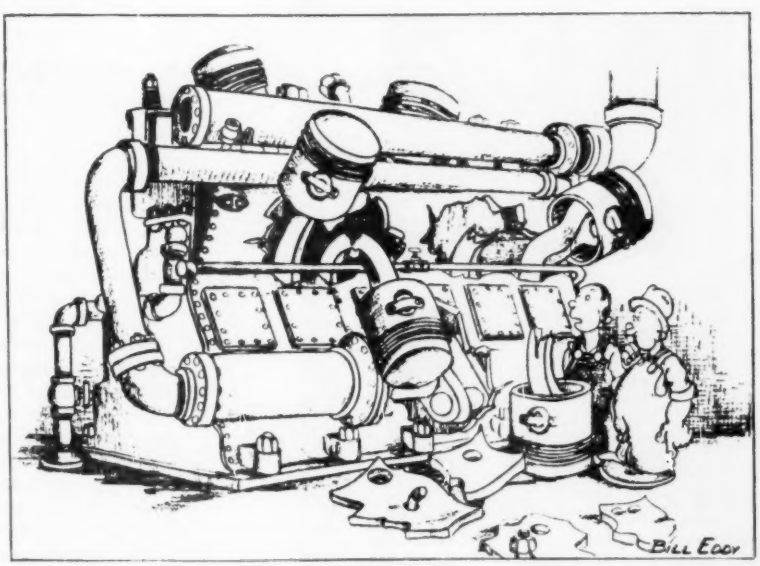
Remove all ashes from ashpit. Examine interior for damaged brick, air leaks and other faults. Check ash-disposal equipment.

Gas firing. Gas-fired heating boilers require attention during the summer, even though the fuel they burn may not be visible. Clean gas burners, being sure that air and gas inlet and outlet openings are free and clear. Test each burner after it is cleaned. See that gas valves and meters are in good working order and that furnace draft system, as well as indicators, are functioning smoothly and correctly.

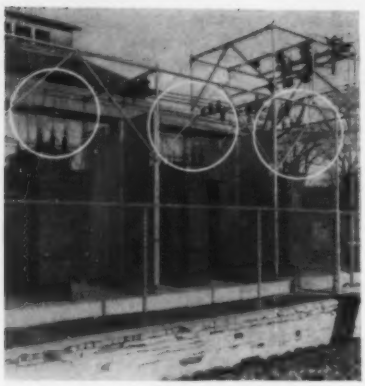
You can get rid of next winter's trouble now if you just take a few days out to see your heating-system is shipshape and ready for work. Why not start today? You'll have the job finished soon, and go back under the elm.

No. 6 of the Bill Eddy cartoons

Repeated by request



"Well, what do you know, Old Bessie's sheddin' again"

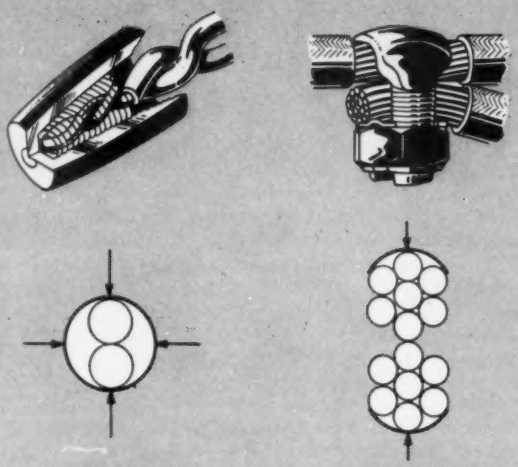


PRIMARY SUBSTATION needs connectors that stand up under weather, electrical and mechanical stresses, plus possible corrosion

SECONDARY SUBS in industrial plants use indent- or bolt-type connectors to carry the heavy currents to production machines

MOTOR CONTROLS for small machines usually have bolt- or screw-type mechanical connector built right into the motor starter

Reliability and easy installation . . .



SCREW-ON **SPLIT-BOLT**

PLANT WIRING connections in branch circuits are often made with screw-on unit, *left*. Connector, *right*, used for heavier taps

Are you making the best

With industrial plants stepping up their major electrical modernization plans, this info on connectors and how they're used is most timely. Next month: How to select the right type

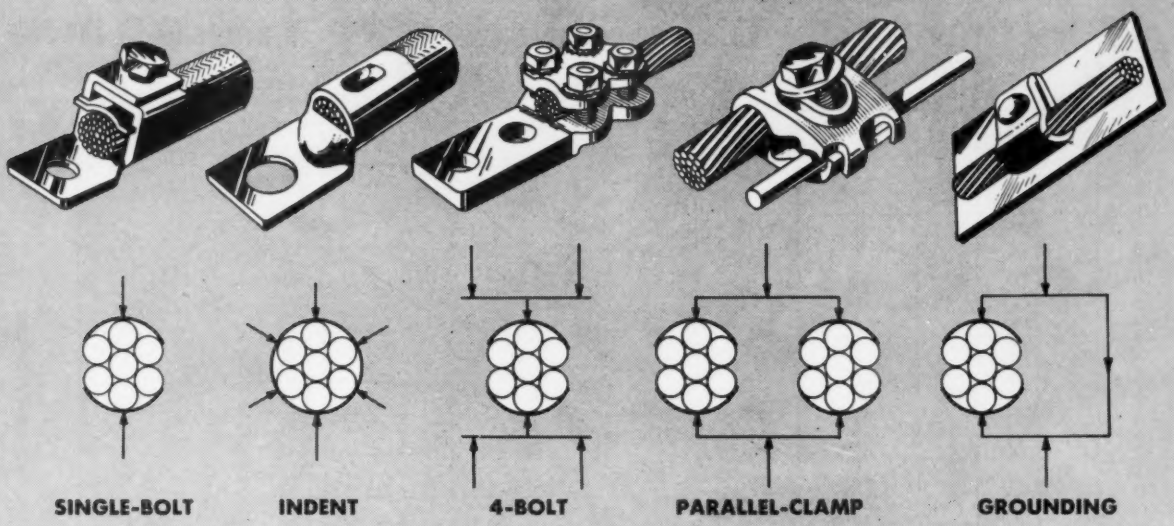
By **MORRIS BRENNER**, *Associate Technical Service Engineer*
Burndy Engineering Company

► DEPENDABLE ELECTRICAL POWER in today's industrial-plant distribution systems hinges on many factors: a reliable source, trouble-free substations, switchgear, transformers and feeders. Spotted through this network you find an increasing number of connectors. They're the links that must prove as strong as any piece of distribution equipment, if your electrical system is to be efficient.

Today's connectors. Keep in mind that widespread use of modern connectors for joints or terminating is of recent vintage. Back at the turn of the century, binding posts were in general use for terminating conductors to equipment. With the growth of electrical applications, solder saw its heyday right through the early 1930s.

Even though solderless connectors were introduced in the '20s, they didn't receive wide acceptance till the late '30s. Marked savings in installation time plus increased reliability of the finished joints led to the sharp decline of soldered splices and terminals. Trend today is toward even wider use

. . . are major factors in widespread use of pressure connectors



WHERE WILL CONNECTOR be used in industrial system? Answer this question first in selecting the type. For high-voltage primary substations, or wherever top reliability is a must, the 4-bolt design or indent type is generally the wisest choice

practical use of today's electrical connectors?

of the compression-type connectors installed with special crimping tools.

Connector's job. A well-designed and properly applied bolted or compression connector distributes the applied force evenly, giving a topnotch electrical connection.

Dependable joints are important from the safety angle, too. A tight,, low-resistance connection is a cool one that won't overheat. Connections properly made with modern connectors run cooler than the conductor itself. A cool joint cuts your I^2R losses throughout the distribution system.

Let's take a look at some of the specifications a connector must meet. In addition to running as cool as or cooler than the conductors, its resistance must be no greater than an equal length of the conductor being joined. Connector must be able to stand up under momentary overloads and short circuits just as well or better than the conductor itself.

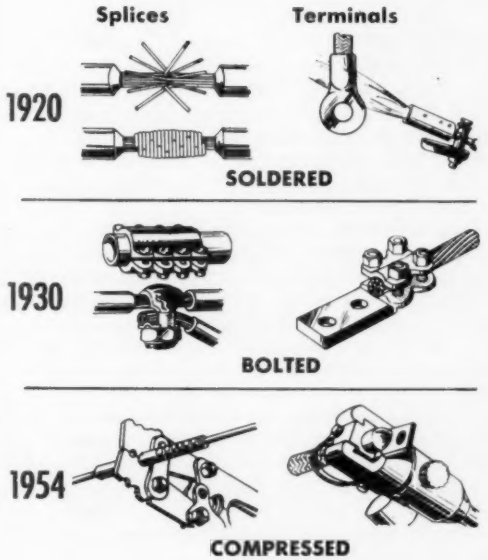
Mechanical needs for any connector you select for your job vary depending on just where you plan to use it in your distribution system.

In outdoor installations, for example, connectors in your primary substation must stand up under wind, sleet, settling ground, vibration, stresses from short circuits and lightning surges. In addition, the connector can't be licked by thermal expansion, or installation stresses that come about in tightening bolts or general connector assembly. Corrosion is an important consideration that must be reckoned with, especially in chemical plants.

Indoor installations must have connectors that will stand through the years under vibration, surges, possible corrosive atmospheres and often operation in high-temperature locations. Most industrial-plant connections are indoors.

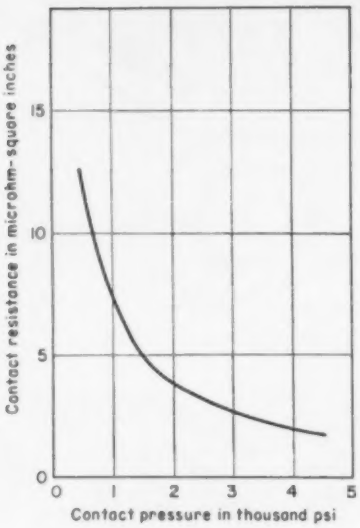
Costwise, consider not alone the first cost but also the

Progress in Connector Design



Both bolted and compression types are used today

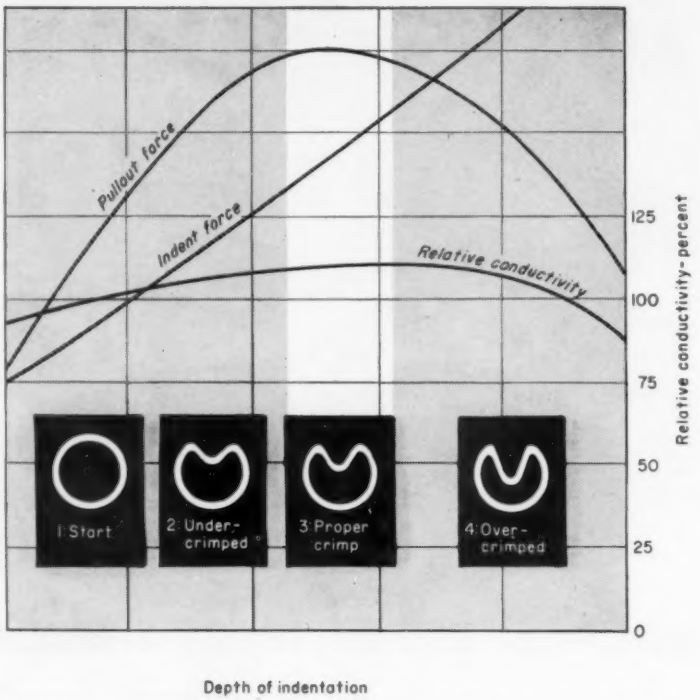
This type connector **is crimped to the...**



Bolt-tightening torques

Bolt-diameter	*In.-lb*
⅜-16	250-300
½-13	450-550
⅝-11	800-1000

BOLT CONNECTOR conductivity and general performance hinge on bolt tightness



COMPRESSION CONNECTORS must be indented to proper depth for top conductivity, pull-out force. Over-indenting damages strands, decreasing conductivity, pull-out

installed cost and what maintenance or trouble calls that connector will cost over the years. Unit you select should be simple, easy to tape where taping is necessary, and designed for quick inspection after installation. Space required is an important consideration, especially in a modernization job.

Consider again the safety angle. Connectors that require a torch for soldering, welding or brazing would be ruled out where hazardous fumes exist.

Meeting the needs. Proper force application lies at the heart of good connector design. How force is applied is brought out in the series of force diagrams atop the two previous pages. Note on some connectors that no mechanical advantage is needed. Here a 1:1 force ratio is ample to yield the force needed for a good joint. On other designs the force applied by the bolts or crimping dies must be multiplied or reduced.

But to make a good joint you need more than force alone: it must be properly distributed over the conductors. Force distribution systems that totally enclose the conductor over a suitable length are most desirable. In such connectors each strand or part of the conductor makes contact in the connector. Example: the 4-bolt clamp type or the indent design.

However, a connector with a totally enclosed force distribution system is not needed for many applications. As will be pointed out next month, the class of duty and location in the distribution system may often call for a lighter design. But these lighter designs must meet the basic electrical requirements for a joint in that their resistance must be as low as an equivalent-length conductor being joined or terminated. Because these lighter designs are more compact and use fewer bolts, they can be installed faster.

Compression connectors. Today's compression designs are made from copper or aluminum tubing with a diameter slightly larger than the conductor. The joint is made by cold-working the conductor and tube into another shape using a special die. This new shape may be an indent, hexagon, reduced circle, flattened oval or a diamond.

Where the conductor and connector are small, a hand-plier-type tool will make the change of shape. Hydraulic tools are in order for a satisfactory joint on large conductors.

As indicated in curves above, a crimped joint, properly made, deforms the conductor strands just enough for good electrical conductivity and mechanical strength.

How deep should you go in crimping a connector? This optimum depth has been carefully figured out by work curves. As shown above, the pull-out force and joint conductivity are plotted against depth of indent. As the die compresses the conductor, pull-out force and conductivity rise till an optimum is reached. If compressed further, strands are overcompressed and both pull-out force and conductivity fall off rapidly. This is good background information to help you understand how a connector should be applied. But you don't have to worry about it since a properly designed crimping tool

proper shape by one of these dies...

INDENT

CIRCUMFERENTIAL

HEXAGONAL

DIAMOND

CRIMPING DIES are available in many patterns. Joint is always made by cold-working conductor and tube into another shape

...set into an appropriate tool

PLIER COMPOUND LINKAGE

CAM TOGGLE

MANUAL

FOOT HAND

PNEUMATIC ELECTRICAL

HYDRAULIC

HOOK U-HEAD

HEADS

CRIMPING TOOLS are manually or hydraulically operated, often with the aid of compressed air or an electric motor on the larger units.

Plier type crimps connectors on conductor sizes No. 22 through 10. Wire cutter and stripper generally built-in to this tool. *Compound-linkage* unit handles No. 8 to 250 MCM by adjusting a single die. *Cam* design crimps No. 8 through 4, boasting a high mechanical advantage. *Toggle* type looks like a bolt cutter and is generally used on overhead work accommodating No. 6 through 2. *Hand-hydraulic* weighs but 9 lb, yet delivers a maximum force of 9 tons; crimps through 500 MCM.

Hook-head hydraulic crimpers develop up to 20 tons and can crimp through 1000 MCM. *U-head* hydraulic builds up to 40 tons and crimps through 2000 MCM. Both heads can be operated by foot pump, electric pump, or a pneumatic-hydraulic pump.

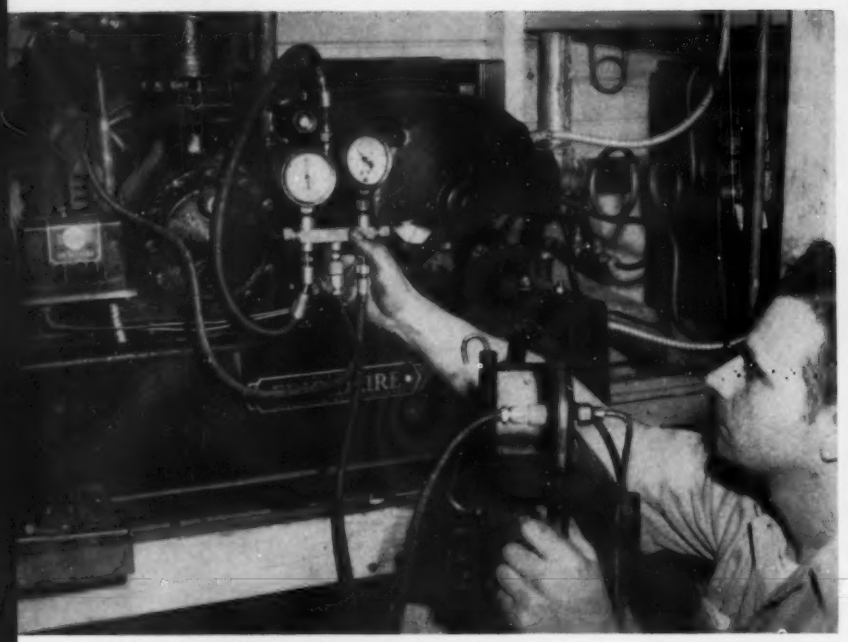
will have the optimum depth of indent built right into it.

For most types of industrial-plant wiring the single indent connector will do. Use double indent units in spots where you meet tough mechanical stresses.

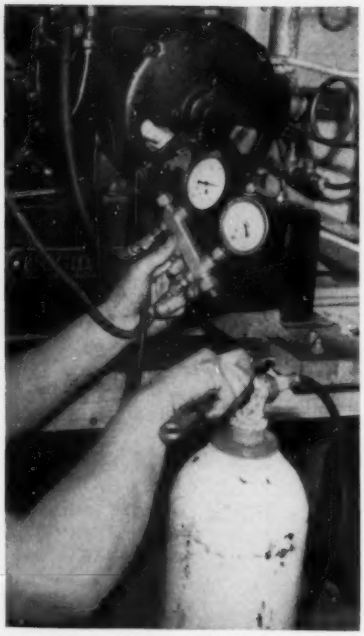
Insulated connectors. It's generally most economical to use an insulated connector where many large cables are to be joined. Such connectors are really insulated buses, designed so many taps can be taken off. The tapped connections can then be easily taped. What does this mean to you? Well a multi-tap insulated connector rules out need for skilled manpower to make and tape an otherwise complicated splice. They come in mighty handy in underground services and where many multiple connection joints must be made.

Other type connectors. But the bolted and compression designs are not the whole story. For instance, the shielded-arc welding process is used sometimes in welding aluminum. Here a blanket of inert helium or argon surrounds the molten filler material and weld puddle, keeping both from oxidizing before solidifying. This technique gives a satisfactory connection on aluminum conductors provided there is enough work involved to warrant equipment and training required.

Thermit connections are another type of welded joint. Here a small crucible is mounted on the conductors and filled with powdered metal, then fired with a special charge. Resulting molten metal forms a welded joint, which has proven quite satisfactory for direct burial. Use care with this method because of heat and flame given off by crucible.



PULLING VACUUM on refrigeration unit is done by hooking testing manifold across compressor. Vacuum pump, hooked to manifold's center nozzle, evacuates system



CHARGING OPERATION utilizes vacuum in system to draw refrigerant into machine

How to install your refrigeration system

"To get top performance from your system you've got to follow the simple rules of careful installation," says Henry Steeneck, ace trouble shooter for a large maintenance outfit. "Here are some of the key points that we check"

► OUR EXPERIENCE shows that most mechanical refrigeration troubles result from insufficient refrigerant or from moisture in the system. Both these headaches can often be traced to careless installation. Sure, we run into a faulty compressor, expansion valve or other equipment defects occasionally. But they're few and far between. I've seen many an operator all set to throw out a perfectly good expansion valve because he didn't check to see that moisture in the system froze up at the valve seat.

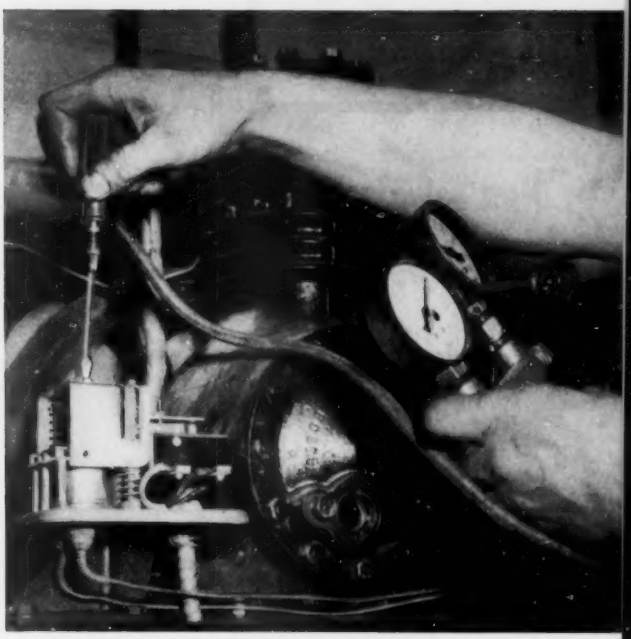
Moisture precautions. Before installing tubing make sure it hasn't been exposed to the atmosphere for more than a few minutes. It doesn't take very long for moisture in the air to collect on the inside of tubing and eventually become the cause of faulty operation. Manufacturers dehydrate and seal tubing at the factory. Following their lead, when we cut off a piece of tubing that is not needed immediately, we hammer the ends. Then, when we're ready to use it, we just cut off the flattened tips.

Coils are factory sealed at inlet and outlet with dead heads. Don't remove these until you're actually ready to hook the coil into the system. Then make the connections as fast as possible—consistent with good workmanship.

I'll never forget the moisture problem we had to tackle last summer. We were installing a 25-ton unit in a cold-storage warehouse. The outdoor temperature was in the 90's, and the humidity was close to 100%. Open-end tubing had been exposed to the hot sun for some time. When it was taken into the relatively cool machine room to be installed, the air temperature inside the tubing took a nose dive, causing considerable condensation to form. We saturated one dryer after another before we realized what was wrong. Rather than dismantle the entire system we continued to use dryers until all the moisture was removed. A little headwork here would have told us that air at 90 F can be sopping wet if it is reduced to 60 F. We learned the hard way not to install exposed, warm tubing in a cold room.

Dryer Hookup. Careful installation keeps moisture down to a minimum, but it's impossible for a refrigeration system to be put in perfectly dry. That's why dryers are used. As an extra measure of protection we always install two dryers. One, a permanent unit, is hooked up after the receiver in the liquid line to the evaporator. The other, a temporary unit, is connected in the suction line to the compressor for about ten days and then removed. To get top perform-

HALIDE DETECTOR is used by trouble shooter to check for leaks. Flame color changing from blue to green detects leak



LOW-PRESSURE CUTOUT SWITCH is set to hold box temperature at desired level. L-p cut-in switch permits defrosting

ance from dryers, always install them in the coolest spot available. Sometimes it is even possible to place them in the refrigerator box itself. This arrangement condenses and absorbs the maximum amount of water vapor.

Connections. The best advice here is to keep the number of connections to a minimum. Where connections are necessary, consider a soldered joint first. If this isn't practical because of future maintenance requirements, use a frostproof flare nut. This type of fitting keeps moisture from getting under the nut, which, upon freezing, will expand and eventually collapse the tubing. Even if freezing doesn't take place, moisture has a tendency to make fittings creep. Expansion valve outlets are one of the biggest offenders in this respect. Moisture collects under the thread, causing the fitting to loosen up. A few months after it is tightened, the condition may occur again. A frostproof flare nut or expansion valve with soldered connections is generally the most practical solution.

Soldering. Where possible, use silver solder. If the tubing is ¾ inch or smaller and the joining members are not brass, the heat from an acetylene soldering torch does a good job. For larger sizes, a welding outfit is usually necessary to supply the heat required. When the joint is in a heat-sensitive location or a welding torch is not available, soft soldering with a 95% tin, 5% antimony solder, is satisfactory.

Evacuating and Charging. After the unit is hooked up, the air must be completely removed from the system. There are several ways to do this important job. Every refrigeration man has his favorite method. We prefer to use the testing manifold, *shown on p 128, left,* in conjunction with a vacuum pump.

The steps are as follows: (1) Connect the testing manifold across the compressor with the compound-gage nozzle fitted to the suction side, and the pressure-gage nozzle hooked to the discharge side, between the compressor and condenser. Both testing-manifold valve stems must be turned to their outermost positions (opened). Start up the vacuum pump and allow it to pull air from the system until the compound gage reads from 29 to 30 inches mercury vacuum. This operation may take from one to several hours, depending on the size of the unit and of the vacuum pump. (2) Turn both manifold valve stems to their innermost positions (closed).

(3) Disconnect the vacuum pump and hook the refrigerant cylinder to the center manifold connection. (4) Open only the pressure-gage valve stem and allow vacuum to suck in refrigerant. Close this valve before the system is completely filled. As long as the sight glass in the liquid line remains cloudy the system is not completely charged. (5) Open the compound-gage valve stem about half way and slowly pull refrigerant into the compressor suction until the sight glass is perfectly clear. The system is now fully charged.

Leak testing. Freon-12 systems are checked with a halide leak detector. This unit consists of a torch and exploring tube that burns with a light blue flame. In the presence of escaping Freon, however, flame color changes to green. Be sure to go around the entire joint when using detector, so all leaks will be discovered. Follow manufacturer's instructions carefully in lighting torch.

Small leaks, eventually resulting in insufficient refrigerant, are the biggest offender with our service men.

If box temperature is high and if unit short-cycles or operates continuously, check for a hissing expansion valve or bubbles in the sight glass. If either of these conditions shows up, make sure the expansion valve is not stuck open or the feeler bulb is not loose on the suction line. Then test for leaks. A few service calls like this, and it's not hard

(*Continued on page* 236)

Correction

Two bottom graphs on air conditioning, p 129 May issue, were inadvertently switched. Also, multiplying factor in text is 0.011, not 0.11.

OPERATORS' NOTEBOOK 75

For best results know

How valve works

► PRESSURE-REDUCING VALVE is an automatic regulating valve for controlling the downstream pressure of a fluid from a higher-pressure source. Three general types are: (1) self-contained internal-pilot piston-operated (2) self-contained external-pilot operated (3)* spring- or weight-loaded direct-operated, with diaphragm, bellows or piston. A self-contained or self-operated valve uses fluid being controlled to operate its main valve.

Valve shown is for steam, air or gas service, with initial pressures from 25 to 1500 psi. This type is built for temperature up to 1000 F, for reduced pressures from 2 to 600 psi.

Principle is simple. Screw down on handwheel to compress the adjusting spring against the metallic diaphragm. That opens controlling valve, which admits high pressure from inlet-body port to top of piston. Piston opens main valve and admits reduced pressure to outlet piping. This reduced pressure acts through the outlet body port (or through an external control pipe on some valves) on the underside of diaphragm to balance compressed spring.

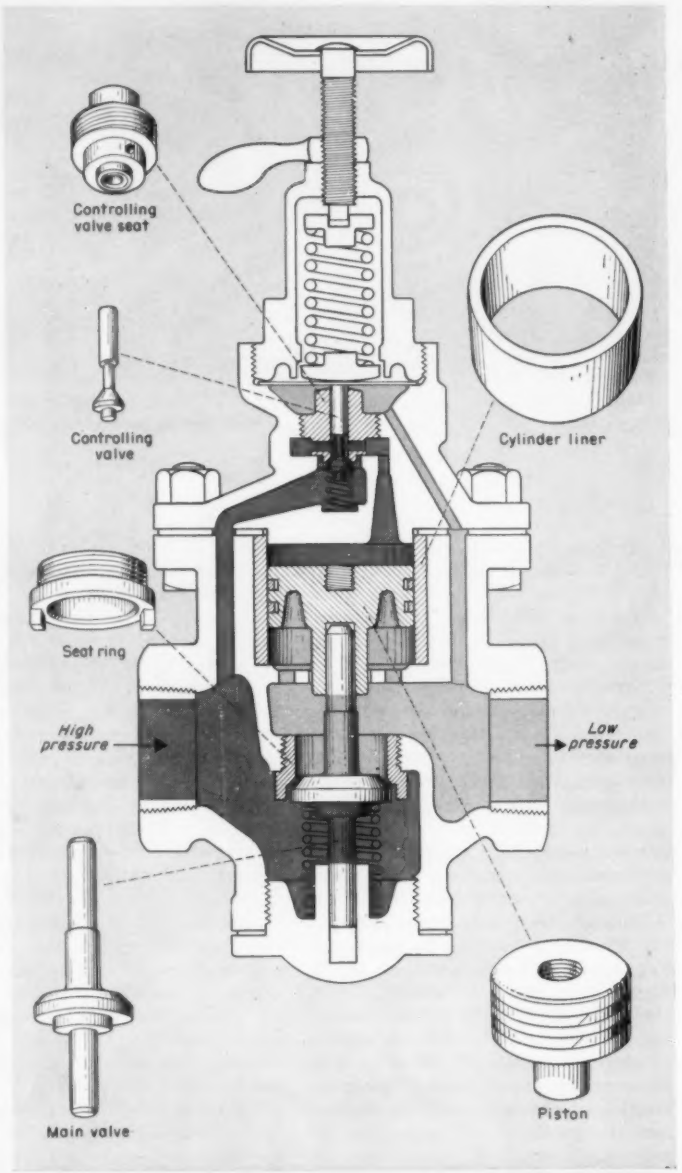
Action caused will throttle the controlling valve and control the reduced pressure at the set value. Any load change immediately reacts with a pressure change on diaphragm, instantly repositioning the main valve. That maintains the constant reduced-pressure setting. Change in reduced pressure affects the valve action.

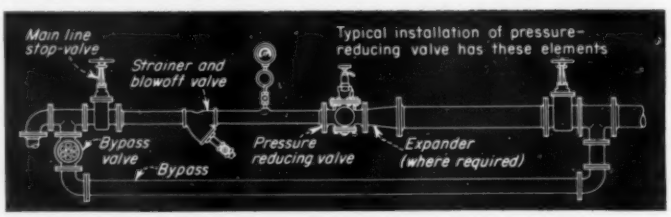
Don't guess at upstream pressure. Use gage at control point to indicate line losses due to friction, which may result in undersizing a valve. Be sure that valve you select is suitable for minimum and maximum load and for superheat conditions.

Never buy a reducing valve to match the pipeline size without checking flow requirement as the line may not be right size to start with. Get information from manufacturer's capacity tables to show size for a given flow and valve design. When reducing to 25% of inlet pressure or less, steam expands in volume two and one half to five times. If you don't know the flow, find it with a flowmeter. Or estimate on basis of equipment performance that valve will service.

Photo, courtesy, Leslie Company

*self-contained internal-pilot piston-operated





your s-c i-p p-o* reducing valve

By STEVE ELONKA, *Associate Editor*

How to keep it working

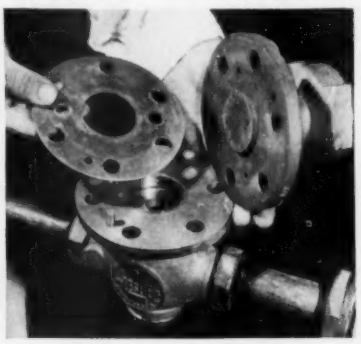
1 Close stop valves on each side of reducing valve, release compression on adjusting spring by unscrewing handwheel

2 Unscrew adjusting-spring case with wrench. Remove case, take out spring. Remove diaphragm with a suction cup

3 Unscrew controlling valve-seat with socket wrench provided for purpose. Remove valve spring and the tiny valve

4 Examine seat and valve. If scored or cut, regrind with fine grinding compound. Clean by dipping in kerosene

5 Check clearance between control valve and diaphragm with straightedge and feelers, against maker's recommendations



6 After assembling spring with valve and screwing controlling valve-seat into top cap, remove the cap and gasket

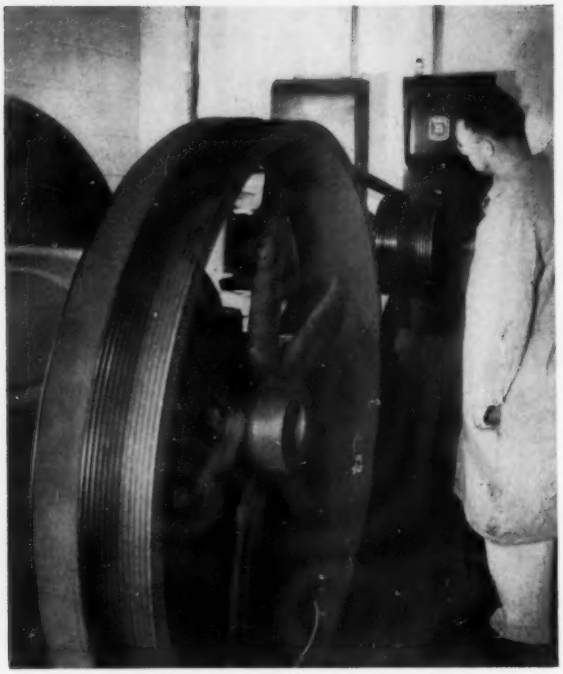
7 Use bolt to remove piston. Examine rings for wear and fit. Remove cylinder liner, inspect the inside for wear

8 Unscrew bottom cap and take out with main valve and spring. Examine for cuts or scored seat, for free movement

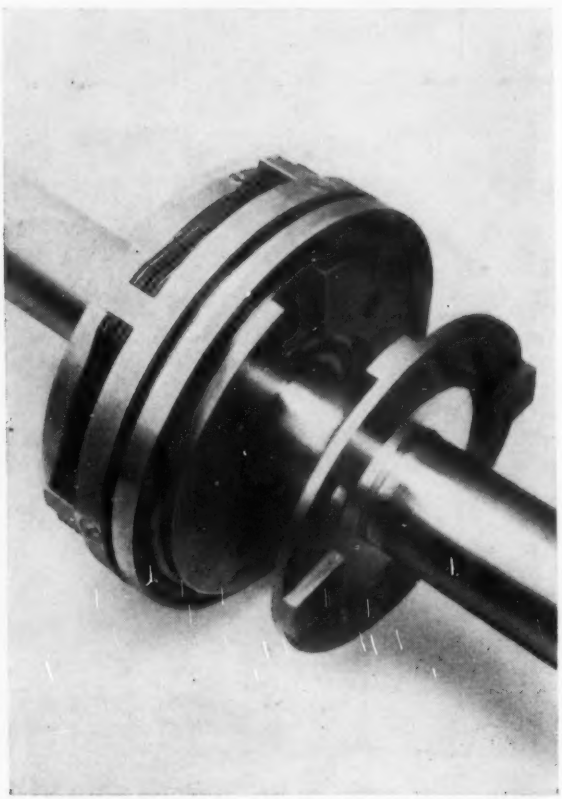
9 If needed, grind in valve with liner and piston in place. Clean parts, check for free movement, then reassemble

Running into tight quarters? These smaller drives may solve space problems

With today's smaller motor and generator frames, the emphasis is upon more hp in less space. Here are two transmission developments that follow this trend

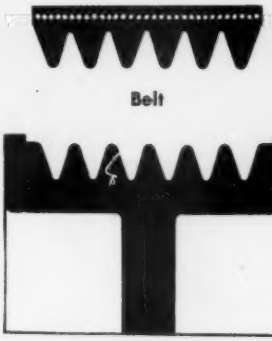


Three-inch-wide belt drives 80-hp air compressor in test run



New electromagnetic clutch boasts absence of friction linings

New belt design



Now that the new NEMA standards allow motor manufacturers to reduce frame sizes, saving space in mechanical-drive transmissions is more important than ever. A new belt developed by Manhattan Rubber Division, Raybestos Manhattan, Inc, fits into this trend.

The ribbed belt pictured, on facing page, promises to deliver same horsepower as a multiple V-belt installation, in a third less space. Saving is in the width. It is possible because the design incorporates a "full-width strength member" (*sketch*) and allows full contact between sheave and belt, providing more contact area than a comparable V-belt drive.

Full contact under even small tension gives a good grip on the sheave, as rubber is incompressible. Synthetic fibers running through the pitch line provide the necessary strength. Fabric covering on under and top sides reduces wear.

Essentially, this belt is a series of V-shaped sections, molded together into one piece. Thus it combines the simple construction of a flat belt with the high grip and positive sheave-groove tracking of multiple V belts.

Sheaves are specially designed to mate fully with the belt ribs; this is intended to distribute load equally over entire width of the drive, and to prevent belt from sinking into the grooves.

Further simplification is possible because the width of the belt may be changed in the field: Merely cut between the grooves for any desired width. Use only one belt per drive.

The two sections available take care of any ordinary power needs by selecting the right width. Test installations have covered drives from ¾ through 300 hp, including an 80-hp single-stage compressor and several deepwell pumps. Possible additional power-plant applications include fans, blowers, crushers, conveyors.

Limitations. This ribbed belt drive can be applied anywhere that a belt drive is suitable, except where (1) variable speed is required (2) the drive would be V-flat (3) the ribbed surfaces would rub against each other or on any other surface. It is not recommended where a single V belt or a flat belt is already doing a satisfactory job.

This clutch has no friction linings

Using today's improved materials and making changes in time-honored designs often results in a smaller unit that does the same job in less space. In turn, this may permit more flexible equipment arrangements, make installation easier, or allow fabrication of an "impossible" drive.

The multiple-disk electromagnetic clutch, *photo, facing page,* is an example of a unit made more compact by eliminating a component required in previous designs. Its disks are made of steel, and friction linings are eliminated. A magnetic field causes the disks to adhere to each other, providing the necessary friction to transmit torque.

The clutch will perform perfectly in an oil-vapor atmosphere or partly submerged in oil, and it is recommended for use inside transmission housings. Unit will engage or disengage a driven shaft while the driving shaft is either running or standing still.

This clutch will soon be manufactured in the United States by the I-T-E Circuit Breaker Co.

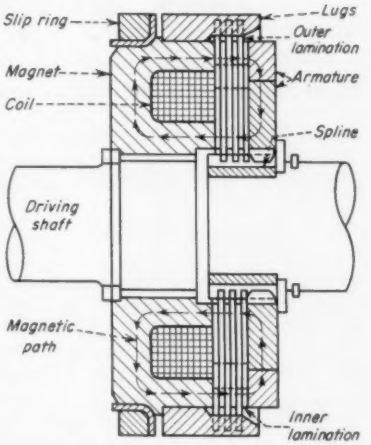
Operation. The magnet, with its embedded coil, is permanently fastened to the driving shaft. Lugs on the outer perimeter fit slots on alternate disks (outer laminations, *see sketch*). A spline on the driven shaft engages both the intervening disks and the armature.

When clutch is energized, control current from a 24-v dc source flows through a suitable brush, not shown, and a slip ring (*see sketch*), then through the embedded coil.

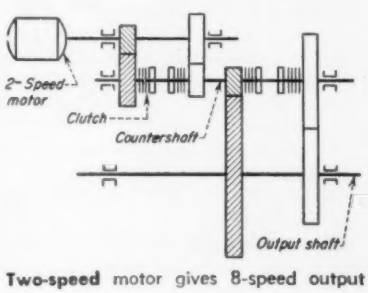
With no current in the coil, the magnet body, with the disks it engages, rotates freely in relation to the intervening disks. Applying the control current establishes a magnetic field, binding the disks together. This binding action between the disk surfaces causes driven shaft to rotate with driving shaft.

Applications. The clutch is available in sizes ranging from 3.2 to 13,000 ft-lb torque. At the present time, it has been used mainly for machine drives. But it shows promise of many other applications in power transmission where automatic preselection of various speeds is advantageous.

In the sketch, *bottom right,* a 2-speed constant-horsepower motor provides eight output speeds by using four pairs of gears and four clutches. The gears having clutches can rotate freely on the countershaft, or can be rigidly connected to it by energizing the proper clutches. Gears are permanently meshed with each other, and consequently may be of any type desired. Spur, herringbone, helical, or even worm gears can be used.

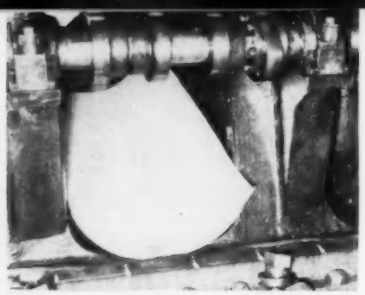


Simplified cross section shows operation

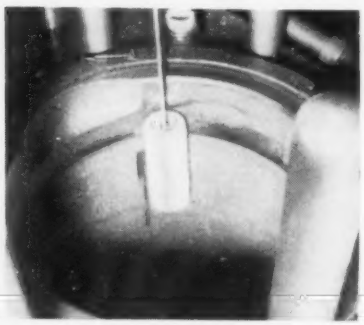


Two-speed motor gives 8-speed output

MIX ONE PART deglazing liquid with one part water in shallow pan. Saturate roller brush. If metal handle is turned 90 deg, straighten it like one shown here



PLACE sheet of gasket material under cylinder in crankcase to protect shaft



ROLL saturated roller over the entire cylinder; start at top and work down

AFTER one hour, brush cylinder with a motor-driven wire brush for best results

Now you can deglaze your diesel liner walls

New liquid solution etches your glazed cylinder walls so you don't have to hone them, says H P Yount of Worthington Corporation. That helps seat in new rings quickly

► RERINGING A DIESEL, gas or dual-fuel engine may not solve your blowby problem unless you prepare cylinder walls so the new piston rings seat in properly. Why? Because the high glaze on a used cylinder wall prevents early or even proper seating. That's why operators often complain that they still have blowby and oil pumping after an expensive reringing job.

Small engines are usually no problem. It's easy enough to use a portable hone to remove the glaze. Honing removes the glaze so rings seat in the shortest possible time.

Large engines are different. It's not practical to hone a large cylinder in a maintenance shop. While I've seen various makeshift homemade hones, they were all awkward to handle, impractical for the job they're built for.

Liquid deglazer. If your liners aren't badly scuffed or ridged, you can treat the walls with a liquid metal cleaner that solves this old problem. There are two such items on the market. One is known as Metal-Prep, made by Sherwin-Williams Co. The other is Adherit, made by Strathmore Products Co.

We have found both these products entirely satisfactory because they cause a light etching effect on the metal and remove the glaze entirely. Just mix with water so solution is half water and half cleaner.

Apply to cylinder with a roller brush from above. If your roller brush is at 90 degrees with handle, straighten out handle as in photos. Then dip brush in solution, roll it over the entire cylinder wall and let stand for one hour. Repeat twice. Then brush the wall with a motor-driven rotary wire brush. Complete the treatment by washing the walls down with water, using the rinsed roller brush. Dry and apply a coating of oil to prevent cylinders rusting until the pistons are installed.

Warning. Solution will light-etch the crankshaft and other parts if it runs down on them. Avoid this by placing a gasket paper or tin troughs under the liners to catch and drain away spillage.

When the reringed unit is started, open crankcase vents to atmosphere. Then listen and look for combustion vapors emitting because of blowby past rings. If there is a minimum of initial vapors, that shows your rings have seated quickly. Then you can expect efficient compression and combustion pressure. And your pistons, cylinder walls and crankcase will stay clean.

Renting an air compressor?

Here are business tips, rental rates

By LESLIE B SCHRAMM, *Secretary, Schramm, Inc*

► As we showed in Power, December 1953, p 123, renting an air compressor can (1) allow you to see if unit has right capacity (2) help in finding right make for your job (3) permit you to try new production ideas without large cash outlays for air (4) aid in writing off compressor cost (5) help take care of peak loads, and (6) give extra capacity for short-term jobs.

Now we're ready to give some pointers on the business side of renting compressors for your plant. You'll find these facts helpful.

Agreements. Have a rental agreement drawn up to protect both you and the man who rents you the compressor. He's called the lessor. You're the lessee. The agreement should contain a statement indicating that ownership of the compressor remains in the name of the lessor. Also, the agreement should prohibit removal of the machine from the plant without written consent of the lessor.

In the event of breach of the agreement, the lessor may retake possession of his property and end the lease. The agreement, *at right*, is typical of those used in Chicago. It is considered sound because it covers all the business points and has a purchase option.

Other forms. Some distributors use the standard portable-compressor rental agreements. These are unsuitable for stationary units because they do not cover state laws related to mounting equipment in the plant, the problems of bankruptcy and use of a unit by a lessee who only rents a plant instead of owning it.

Rates vary with locality, type of rental and use of the compressor. The Associated Equipment Distributors (AED), a national organization, publishes suggested rental rates; see table at end of article. These rates are primarily for stationary compressors rented for construction jobs, but some dealers use them for industrial plants.

To establish a monthly rental rate, some lessors divide the total equipment cost by 12. Delivery and pickup are extra. Rental recapture is 100% for the first 30 days; 5% is deducted for each 30 days until the unit is purchased.

(*Continued on page* 234)

EQUIPMENT RENTAL AGREEMENT

THIS AGREEMENT made by and between STANDARD AUTOMOTIVE EQUIPMENT, INC., 3751 Ogden Avenue, Chicago, Illinois, Lessor and_____, Lessee.

WITNESSETH:

That the Lessor, for and in consideration of the convenants and agreements herein contained and to be kept and performed by the Lessee, has leased to the Lessee the following described personal property, to-wit:

_____

_____

_____

_____

to have and to hold the same unto the Lessee for a period commencing the____day of____, 195__, until the____day of____, 195__, and for each____thereafter until said property is returned.

And the Lessee, in consideration of said leasing, covenants and agrees with said Lessor to pay as rent for the personal property hereinabove described the sum of $____per____, beginning____, 195__, and the same sum of money on each____thereafter until said property is returned.

Lessee also agrees to pay the sum of $____for delivery and pickup charges.

The possession of the above-described personal property by the Lessee shall not in any way be considered as evidence of ownership, it being expressly agreed between the parties hereto that the title to said property shall at all times remain in the Lessor and said property shall not be removed from the premises of the Lessee, located at_____, Chicago, Illinois, without the written consent of the Lessor. In the event of a breach of this covenant, Lessor may retake possession of said property wherever it may be found, and may terminate this lease and retain all monies paid herein as liquidated damages. In the event of default, Lessee agrees to pay a reasonable sum for plaintiff's attorney's fees and court costs.

Upon the termination of this lease, the Lessee agrees to deliver to the Lessor the property hereinabove-described in good condition and repair, reasonable wear and tear excepted, and in the event said property is not in good condition and repair, Lessee agrees to pay to the Lessor the reasonable value of said machinery and equipment which is hereby fixed by agreement of the parties at $____.

Lessee shall not remove, alter, disfigure or cover up any numbering, lettering or insignia displayed upon the equipment, and shall see that the equipment is not subject to careless or needlessly rough usage; and it shall at its own expense maintain the equipment and its appurtenances in good repair and operative condition, and in such condition return it to the Lessor.

Lessee shall and does hereby indemnify the Lessor against all loss and damage to the above-described equipment during the rental period, and agrees to pay the cost of all repairs or renewals, including labor, material and parts. Any damage claim of either party shall be made known to the other party within five (5) days after receipt of equipment, or such claims shall be void.

Lessee shall and does hereby indemnify the Lessor against all loss, damage, expense and penalty arising from any action on account of personal injury or damage to property occasioned by the operation, handling or transportation of any equipment during the rental period.

Before the equipment is loaded for transit to the Lessee, it may request and receive an inspection thereof by its duly appointed agent or employee. Lessor shall have the right at all reasonable times to enter the premises in which the equipment is located during the rental period for the purpose of making an inspection thereof.

Should the Lessee defer any payment more than seven (7) days, or become bankrupt, or fail to maintain or to return the equipment as provided by this Agreement, or substantially violate any provision thereof, Lessor may, upon five (5) days prior written notice, terminate this Agreement, take possession of the equipment without becoming liable for trespass, and recover all rental due, full damages for any injury to, and all expenses incurred in returning the equipment.

Lessee shall at its own expense carry and maintain theft, liability and fire insurance and such other insurance as requested by the Lessor and any special liability policy carried for this particular lease shall name the Lessor as one of the insured thereon.

This equipment shall not be sublet by the Lessee, nor shall it assign or transfer any interest in this Agreement without written consent of the Lessor.

OPTION TO PURCHASE

The Lessee shall have the option to purchase the equipment herein leased, at the price hereinabove fixed by the parties as the reasonable value of said equipment. If this option is exercised within the first thirty (30) days of this agreement, then any sum of money paid for rental will be deducted from the purchase price. In the event the option is exercised after thirty (30) days, then the Lessee shall be entitled to a credit on all rentals paid less five (5%) per cent, if the option is exercised in the second month of the rental agreement. An additional five (5%) per cent will be deducted from the rental credit for each month thereafter, if the Lessee elects to purchase the equipment during the term of this lease. The option herein contained shall also apply in the event the Lessee desires to purchase a new piece of equipment of equal or greater value than the equipment leased hereunder.

IN WITNESS WHEREOF, the parties have caused this Agreement to be duly executed at Chicago, Illinois, on the____ day of____, 19__.

_____ (Lessee)

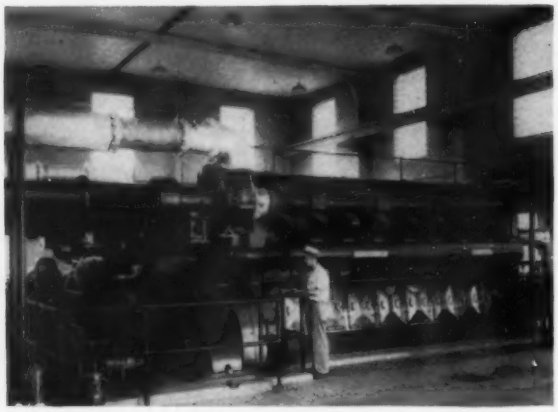
BY_____ (Authorized to sign for Lessee)

STANDARD AUTOMOTIVE EQUIPMENT, INC. (Lessor)

BY_____

TYPICAL RENTAL AGREEMENT protects both lessor and lessee from misunderstandings and defines the responsibilities that arise when rented equipment is installed

Newest PRACTICAL IDEAS for a bang-up job to cut



Color consultant makes plant harmonize

WHEN OUR $500,000 diesel plant was completed, everyone smiled with relief. We had 3000 kw in three individual power units, each a power plant in itself. Things ran smoothly with the new crew, but something was missing.

We needed a paint job! Walls were raw brick, engine painted dark as in mining camps. So a color consultant from a paint firm helped us out—"for free." He had multicolor miniature setups of diesel engines, turbines, generators—all we did was keep "pushing buttons" until we liked the combination.

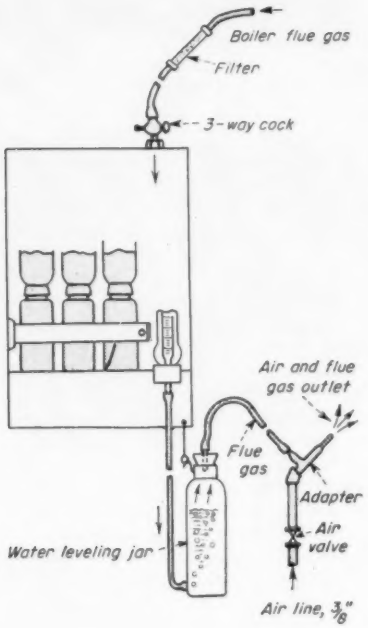
We picked a flat, light cascade green for walls. He agreed. Then we spotted a light green enamel for engines and generators. "No good." That would show oil that might leak around engines. He picked dark green—we agreed.

Turbocharger exhaust had been insulated against 750 F. When painting, we took no chances and used a silicone-based high aluminum. After three years, still no burn-through.

He had a floor paint, but he didn't want to defeat the safety feature of our special new antiskid concrete. We left it as is. Acoustic ceiling helps reduce engine noise. Should we paint that? "Nope, it's still brand new, and looks OK." We painted out the girders and knee braces to make them blend with ceiling. Painting the crane run girders the same color as the walls makes them less obvious.

Now, operators take added pride in keeping our plant ship-shape and sparkling. As one visitor said, "Your diesel plant looks like an automobile showroom." And why not? We expect to work here a long time.

L W FITZPATRICK
Jefferson City, Mo.



Drawing flue gas without aspirator bulb

SKETCH SHOWS an easy way to draw flue-gas sample without using aspirator bulb or gas pump.

From your 3-way cock, *sketch above*, hook rubber tubing to filter, then to boiler sample line. Suspend leveling bottle by hook to a wire about 6 in. or more below cabinet. Use a rubber cork that fits easily into top of leveling bottle. Then insert short ¼-in. glass tube or piece of copper tubing through cork.

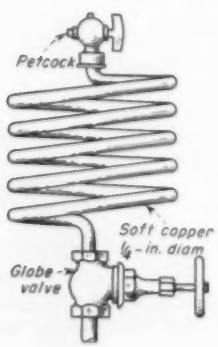
Attach rubber tubing to one end of this short tube, then directly to a 2-way adapter, connected as shown to a ⅜-in. air line. By opening air valve slightly, flue gas will siphon through burette and measuring bottle. This is shown by bubbling, which should not be too rapid.

When enough gas is drawn through, leave the air valve set and simply pull the cork from leveling bottle. Then raise the bottle to start the test.

To extract another flue-gas sample for analyzing a sample, place cork in bottle, and air siphon will do its work again. You can tell amount of flue gas coming through by bubbling in leveling bottle.

To make this apparatus really useful, you should have air outlets near your various boilers. Then it's easy to hook to air line near boiler being tested.

B WAINIKKA *Terrace Bay, Ont.*



Coils stop water hammer

I INSTALLED copper coils, *sketch*, on our water system to cure water hammering. It works well on either hot- or cold-water pipes.

Soft copper tubing is ¼ in. OD, bent around a diameter of four to five inches, with four or five coils. I install a ¼-in. stopcock to waste on bottom of coil and a ¼-in. petcock on top of coil to vent it if necessary. After months of service, it has solved our problem.

A KUCHINSKY *Arlington, Mass.*

your costs of operation and maintenance

STEVE ELONKA, *Associate Editor*

Gage glass rack has tool box

WE MADE and mounted a gage-glass rack near steam drum in a warm and handy place. It has wrenches and packing in an attached box so we can replace a glass in a few minutes. With everything at hand, glasses are changed in shortest possible time.

D E HALE *SS California*

What caused sparks?

INTERNAL FLOAT in the steam trap stuck, so our maintenance man tapped trap with a machinist's 24-oz. ball-peen beryllium-bronze hammer.

He saw sparks flying from point of impact where hammer struck the painted surface of trap. Trap was for low-pressure steam of 5 psi. Casting was cast iron, painted with several coats of commercial grade of aluminum paint.

Because the hammer was thought sparkproof, question was just what did cause the spark. One theory was that aluminum flakes being loosened by hammer were heated by impact and burned in air.

Experiments published in *Journal of Applied Chemistry* indicate that sparks can be produced when such surfaces are struck by objects made of mild steel, brass or aluminum. Sparks produced in this manner explode air mixtures of flammable gases, such as coal gas or carbon disulfide. Conclusion was that such sparks are from the thermite reaction in which iron oxide and aluminum metal react with evolution of great heat. This info helps avoid sparks when gases might cause explosion.

Courtesy, Sentinel Factory Insurance Assn

What would you have done?

VACUUM NOSE dived from 26 to 18 inches on our 15-kw turbine set. This set is used evenings to carry peak load alone because it is most economical for the purpose.

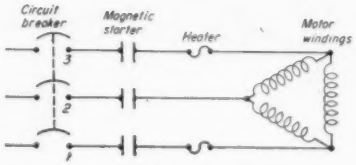
Because of low vacuum we had to put on an extra boiler, which jumped coal consumption way out of reason. Engineers feverishly searched for air leaks in vacuum system. Some used soap suds, others lighted candles. Still others tried to listen to inrushing air at suspected places.

This went on for days while management got impatient. Finally, the manufacturer was called in. He sent two "experts" who searched for two weeks before they gave up. By then management and engineers weren't speaking.

That's when the Old Chief got busy. He began painting the entire vacuum system with shellac. He worked night and day, finishing everything under the engine-room floor, then started above. For good measure the Old Chief even painted the bearings. Then he tackled the equalizing line, but vacuum was still 18 inches.

Looking at the copper expansion joint in the equalizing line, he mused, "Hell's bells, that's copper, it can't be there." But since he had painted everything else, he slapped shellac on that, too. And, eureka! There was the leak in the rear side. It was a 10-in. crack, caused by repeated expansion and contraction. We fixed that temporarily by wiring a piece of sheet rubber around the joint. The vacuum shot up to 26 inches—but it took almost a month to find that leak. What would *you* have done?

J W BLAKE *New York, N. Y.*



Buy a volt-ohmmeter

THE SOONER power men start using the radio man's standby—a volt-ohmmeter—the easier their jobs will be.

A 3-phase motor won't start, and "kicks out" on overload. Is it worn bearings, mechanical overload, or an electric-problem? In a minute or so a volt-ohmmeter shows if it's electrical.

From the circuit breaker to the motor windings there are innumerable connections that can give trouble or low voltage. Close the starter by hand (circuit breaker is open) and test between points 1 and 2, 2 and 3, 1 and 3. If the resistance values are equal and each phase to ground shows a high reading, then the starter, wires and motor windings are OK.

Check the voltages at the breaker. If they are equal and correct, the trouble is mechanical. Separating the driver and driven unit isolates the trouble.

For checking continuity of coils, resistances, etc, it can't be beat. Beauty of using an ohmmeter is everything is tested cold.

F J ARDOLINO *Brooklyn, N. Y.*

Protect cables from heat

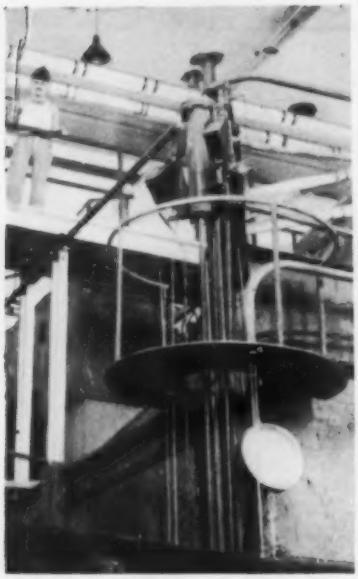
HERE'S HOW to protect electric cables exposed to hot, outside temperatures without renewing them. Paint with insulating varnish and, while still wet, sprinkle a thick coating of finely powdered boiler lagging.

W E WARNER
Woodford Green, Eng.

(*Continued on page* 138)

More PRACTICAL IDEAS

Begins on page 136



Circular platform helps maintain water columns

BECAUSE OUR MECHANICS didn't like to work on the boiler's water columns, we built a 270-deg circular platform, photo. Water columns are about 25 feet above floor plates. Platform is 4½ ft below the columns and has handrails made of piping.

This proved so useful, we built platform for two other boilers. They are welded to side and front of boiler's horizontal beams. Two holes are made in platform through which to pass gage-glass valve's chains. Material is corrugated ⅜ in. steel sheet. Now we have no problem when mechanics have to inspect or repair water columns.

J R BROWN *Bauta, Cuba*

Good use for old flashlight case

IN THAT "I-may-need-it-for-something-some-day" section of the house, most handy men can find a flashlight case that no longer lights for some reason. Along with this we have the man who works out of a tool box. He has problem of finding his pencil points broken, chalk crushed, and soapstone broken. Usually all soft articles are a mess when mixed in with tools.

We now have a problem and a useless article, which is a perfect combination for a gadget. If the breakable articles are carried in the flashlight case they are always ready for use. And they will also be handy when needed.

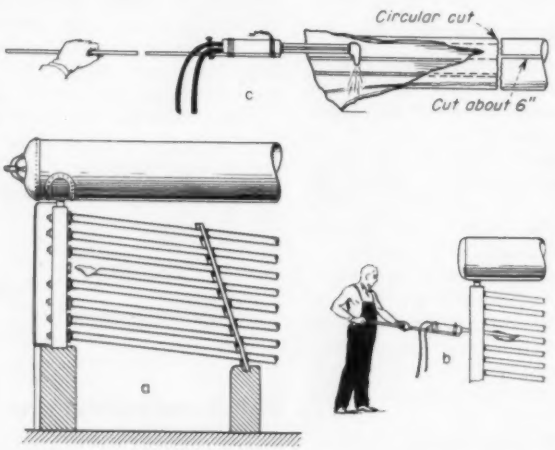
A R TANNER *Cold Spring, N. Y.*

Spring guide does away with wire feeders

PULLING ELECTRIC WIRES through conduits can be a one-man operation. When guide in photo is used, no feeder is needed at start of conduit, regardless of how many wires are pulled through. Guide is a tempered-steel spring, attached to a light-weight knurled aluminum body, which screws onto conduit. Smooth contours of spring-end eliminate stripping and shaving of insulation on sharp edges of conduit or box.

Partly because of its flexibility, guide removes all but knottiest kinks and snarls in wire. It eases pulling of wire in hot weather; some pulling compound placed in guide automatically lubricates wire as it's pulled through. Guide is manufactured to standard conduit sizes of ½, ¾, 1 and 1¼ in. Special sizes are sold by me—I make them. No tools needed to attach guide to conduit.

G G ZACHARY *El Monte, Calif.*



Torch removes flattened tube from boiler

I WAS CALLED ON to remove a tube that had split open in a boiler. Because tube had opened up to shape of flat sheet, my problem was to remove it from tube nest without harming other tubes.

After getting a cutting torch with shortest nose, I wired a piece of 1x2-in. wood, about 6 ft long, to torch. Then I lighted torch to right flame and inserted through handhole as shown.

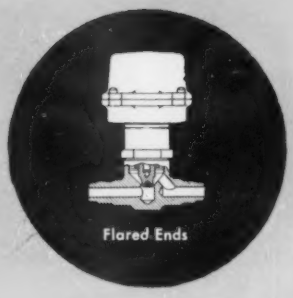
I made four cuts straight down the tube for a distance of about 2 in. below the break, then a circular cut intersecting the four cuts. This allowed the four pieces to drop down between the other tubes. Next, I cut straight down the tube again so the tube would squeeze together for easy removal.

ED DUFF *Aurora, Colo.*

(*Continued on page* 140)

POWERS

First with duo-seal PACKLESS CONTROL VALVES

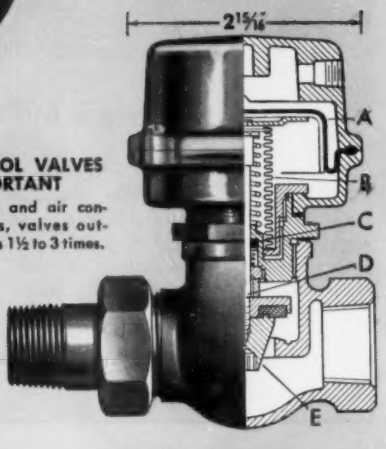


DURABLE AIRTIGHT CONSTRUCTION

GOOD CONTROL VALVES ARE IMPORTANT

On many heating and air conditioning systems, valves outnumber thermostats 1½ to 3 times.

Available in Various Types and Sizes

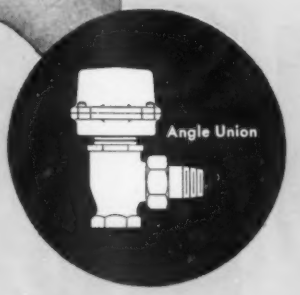


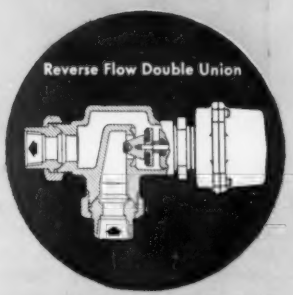
Rugged Cast Aluminum Top

A) Durable Molded Diaphragm
B) Bronze Bellows, Primary Seal
C) "O" Ring, Secondary Seal
D) Polished Stainless Steel Valve Stem
E) Characterized Throttling Nut

More ACCURATE Control with Powers PACKLESS Valves

Minimum valve stem friction. No packing nut or gland to be tightened, oiled or adjusted. No binding of valve stem as with conventional packing. Powers **duo-seal construction** assures better performance and—





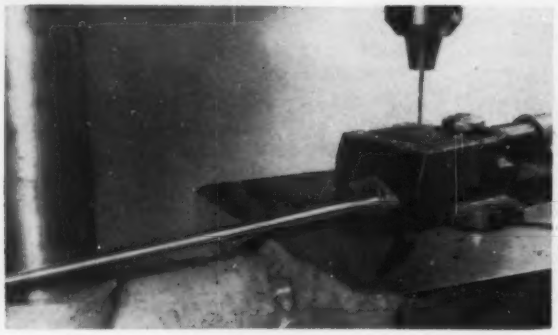
No Packing Maintenance. No Leakage of Water or Steam. No Loss of Vacuum.

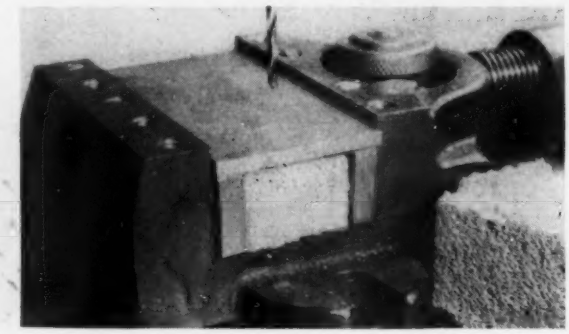
To insure getting a temperature control system with the best control valves made for convectors, unit air conditioners, unit ventilators, radiators, panel heating and cooling coils—specify or install POWERS pneumatic control.

Established in 1891 • **THE POWERS REGULATOR COMPANY** • SKOKIE, ILL. • Offices in Over 50 Cities

More PRACTICAL IDEAS

Begins on page 136





Two handy ways to make your drill press operations easier

SIMPLE WAY to hold vise: Drill horizontal hole in back face, drive steel-rod length in hole. Let protrude enough to engage drill-press column, *first photo.*

One headache when supporting work in a drill-press vise with parallel strips is tendency of strips to fall sideways. That usually happens just when work is being placed on them. Parallel strips are also used on vises of shaper and milling machine.

Second photo shows way to make vise parallels stay upright. Slip a block of very soft sponge rubber between parallels. Sponge rubber always exerts enough pressure against parallels to keep them from falling.

Rubber also reduces tendency of work to rebound. For most vise work, job is hammered down on top of parallel surfaces to insure accuracy. Hammering work causes it to rebound from jaws, then time is wasted in making job come into close contact with tops of parallels. Rubber exerts a strong damping effect and virtually eliminates work-bounce.

C T BOWER *London, Eng.*

Hoist saves scrap dollars

OUR FIRM installed a 92-ft-long disposal dock and divided it into one-ton-capacity sheet-steel bins. Each bin holds a different type of scrap. Some that are more valuable than others would have much lower resale value if mixed with inferior grades.

To solve problem, every bin load of scrap is weighed by raising bin to truck level with an overhead hoist. A weight indicator is placed between hoist and bin, tallying each "lift."

Weight indicator shown is a 0-5000-lb-capacity model. It has a 16-in.-diameter dial and is easy to read even from a distance. Scale also has a rapid reset adjustment, which comes in handy.

R E DILLON *Van Nuys, Calif.*

Fuel-nozzle test stand

PHOTO SHOWS our homemade fuel-nozzle test stand. Nozzle holder is 2-in. pipe with prongs going up on each side of inlet nipple-projection to keep body from turning. We used steel rods for the framework. A cutoff antifreeze can is brazed to the cross rods to hold the glass jug.

We bought several jugs from local soft-drink bottler for a nickel apiece. Jug is removable as a unit by first loosening butterfly nut in plate's center across base of unit. Butterfly nut is on bolt that goes through bench. Big advantage of this setup is that action of spray is visible and floor does not get covered with dangerous oil.

D L COCHRAN *Milaca, Minn.*

Color code for safety hats

ONE OF the largest industrial users of color code to identify plant departments is the Higgins Co, in New Orleans. Leon J Baker, safety director, says, "In our firm no man is allowed to work unless he wears a hard safety hat. Hat is included in our union contract. Because each trade has its own color, we can tell department every man belongs to. If we see a blue hat in with yellows, we know someone is not working in the right place, or perhaps not working."

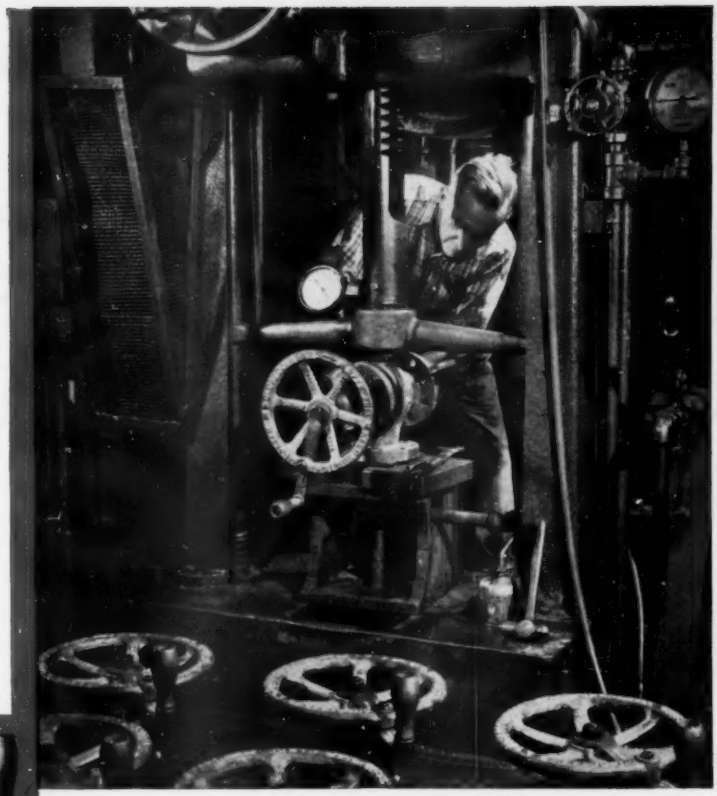
Here is their color code: red—pipe workers; blue—fitters; green—welders; buff—rigger; yellow—electrical; black—labor; gray—burner; brown—carpenter; brown bottom, white top—painter; red bottom, blue top—machinist; gray bottom, white top—shear and blacksmith shops; lavender—expediters; aluminum—general foremen; brown, yellow top—calkers and sanders.

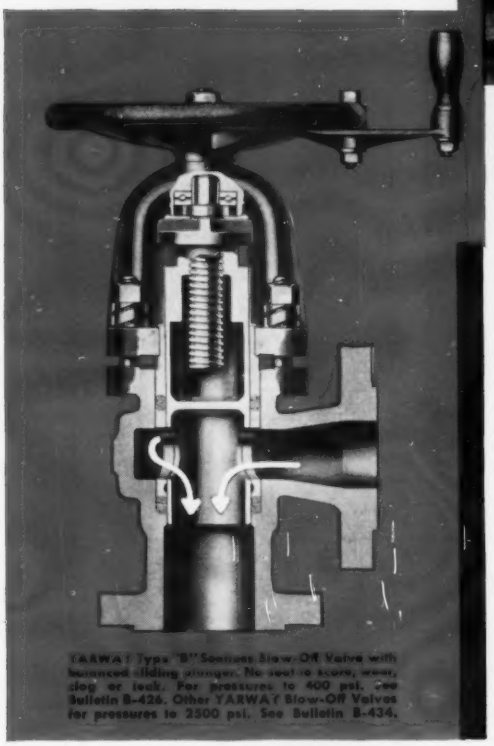
This firm also stencils every workman's badge number on front of his helmet in letters ¾ in. high.

Portable torch pot

MOUNT A TORCH POT on casters for multiple boiler plants so it can be wheeled to boiler that's being lit. This does away with dribbling all over the deck. It sure works well in our plant.

H HOLCOMBE *Los Alamos, N. M.*





YARWAY Type "B" Seamless Blow-Off Valve with bonnet-sliding plunger. No seat to score, wear, clog or leak. For pressures to 400 psi. See Bulletin B-426. Other YARWAY Blow-Off Valves for pressures to 2500 psi. See Bulletin B-434.

THIS PRODUCTION "DOUBLE CHECK" SAFEGUARDS YOUR BOILER INVESTMENT!

■ Yes, here is one extra production step we will never bypass! It is your guarantee of a *dependable*, long-life blow-off valve.

In this corner of the YARWAY Testing Department, *every Yarway Blow-Off Valve* is hydrostatically tested at 1½ times its rated maximum working pressure—proved drop-tight for service far beyond normal expectancy.

Not only blow-off valves, but *all* YARWAY equipment undergoes rigorous tests before leaving the YARWAY plant. Why? For one reason—to assure longer and better service in *your* plant. Over 15,000 boiler plants are using YARWAY Blow-Off Valves—some for twenty-thirty years, or longer.

Whenever you are in need of boiler blow-off valves, be sure to *make Yarway your way.*

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YARWAY

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
REMOTE LIQUID LEVEL INDICATORS
EXPANSION JOINTS
DIGESTER VALVES
STEAM TRAPS
STRAINERS
SPRAY NOZZLES

PLANT PROBLEMS . . . *helpful info from readers*

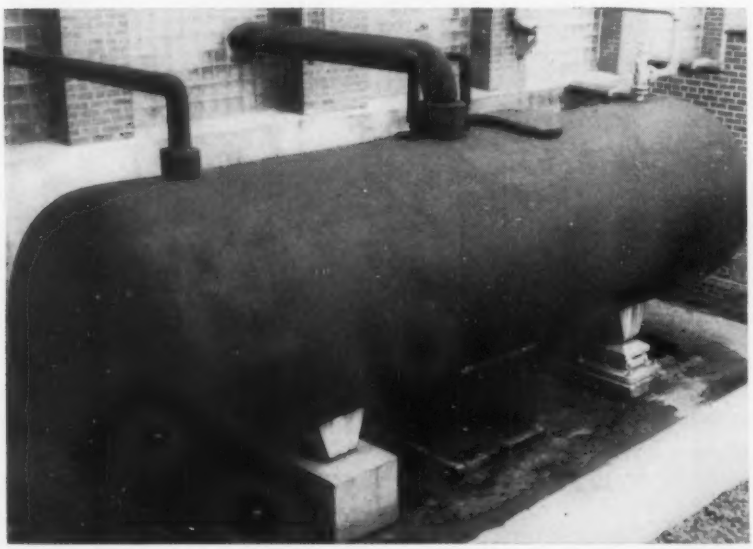
Will an accumulator help this hosiery plant?

HERE ARE THE FACTS: Our hosiery mill produces many types of stockings in steam-using machines. Steam demand of these machines is high during the starting period, then tapers off.

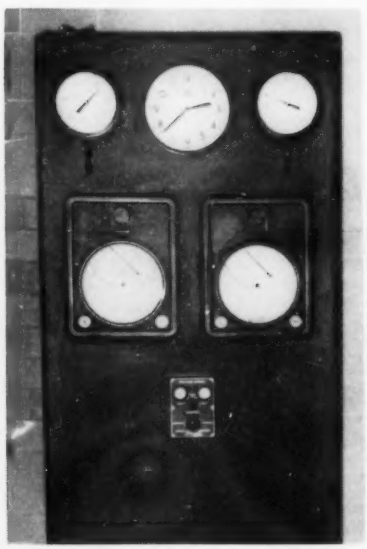
Our big problem in production results from the high demand of individual machines and the difficulty of predicting when a given machine will start. If we start more than one at the same time, steam demand is many times that of the normal requirement.

Will an accumulator between our boilers and manufacturing units cure this condition? How should the unit be piped? Is there any approximate relationship between the boiler capacity, the system demand and the size of the accumulator needed for plant? ***FG, March Power***

Here are the answers



HOSIERY-MILL accumulator is installed outside mill basement. Gage glass, vent, feed line and blowdown valves are inside basement wall to protect them from frost



CONTROL PANEL for accumulator has the pressure gages and recorders for it

PHOTOS and chart show an accumulator we installed in a hosiery mill to smooth boiler firing rates and reduce pressure changes in low-pressure (l-p) ma ns. Note on the chart how both the boiler and l-p main pressures remain constant while accumulator pressure varies widely.

This accumulator is installed outside the factory basement. Gage glass, vent, feed line and blowdown valves are inside the basement wall. Box at the bottom of the accumulator encloses the blowdown line and gage-glass water leg and is open to the basement to prevent freezing. Though this plant is in a fairly temperate climate, accumulator is well insulated to reduce heat losses.

DON KELLAND *New York, N. Y.*

For your new questions, see page 144

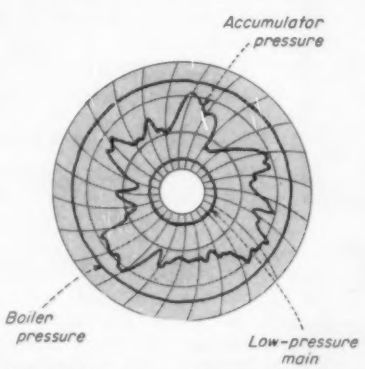


CHART shows how well accumulator keeps pressure constant in boiler, l-p mains

ECONOMICS now influence accumulator use more than in previous years. With the price of boilers higher and wider use of package units, the accumulator becomes more desirable. Lastly, the cost of an accumulator today is not much more than it was several years ago.

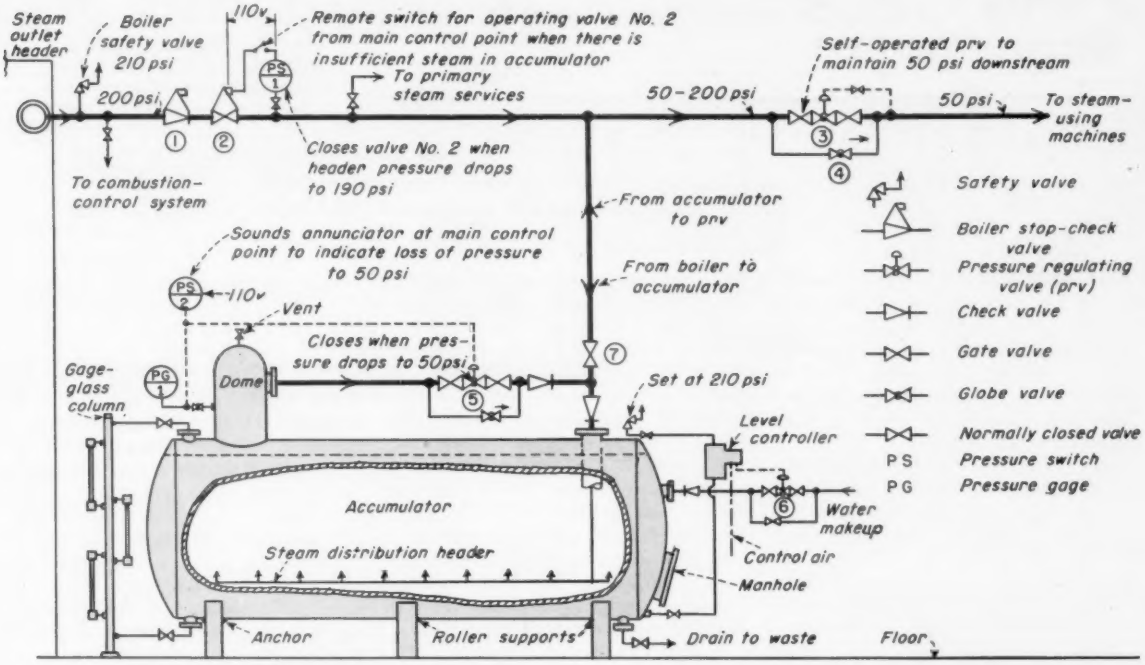
For batch-scheduled plants and similar applications, the accumulator working with an automatic package boiler gives an extremely low-cost hookup for supplying base loads and peak demands.

The equipment is arranged so the boiler runs constantly at its most efficient output, storing steam in the accumulator. Boiler load increases only when process system demands steam from the accumulator.

So *FG* would be wise to make an eco-

on accumulators, grounding neutrals

TYLER HICKS, Associate Editor



TYPICAL ARRANGEMENT of piping, valves and controls for a textile-mill accumulator installation

ACCUMULATOR increases the average efficiency of *FG*'s boilers by reducing the variations in steam demand. Installation like that in the sketch absorbs load swings without difficulty. I've assumed a boiler pressure of 200 psi.

In the hookup shown, valve *1* is a *Code* requirement, while *2* functions as an automatic isolater when header pressure falls below 190 psi. Valve *3* is a self-operated prv to supply 50-psi steam to process. Steam leaves the accumulator through the dome and valve *5*.

During periods of unusually high steam demand, accumulator pressure may drop to the assumed minimum process pressure, 50 psi. When this occurs, valve *5* closes to prevent further discharge and pressure switch *2* energizes a circuit to sound an annunciator or send some other signal to the main control. It opens valve *2*, if desired.

Accumulator makeup may be controlled automatically or manually. Water should be supplied at high pressure for makeup. Fit a drain for water removal, a manhole, water-level gage and pressure gage. A safety valve is required on the accumulator shell, as shown. Valve *7* is for isolating the accumulator for maintenance.

Assuming the pressure conditions shown, a storage capacity of 20,000 lb and 95% of the accumulator volume filled with water, total volume of the unit will be 3830 cu ft.

FG can save at least 10% of the fuel he now burns if he installs an accumulator. Boilers and firing equipment will require less maintenance, and there will be savings in labor.

A J BREUGELMANS *New York, N. Y.*

---

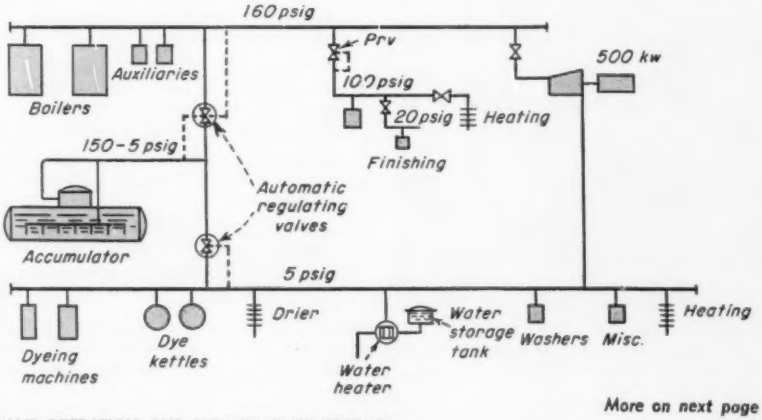
nomic study of his plant before going ahead with any work. He may find his present boilers will work well.

DAVID SMITH *New York, N. Y.*

TEXTILE ACCUMULATOR hookup is shown in sketch, *right*. This plant is fitted with boilers to supply steam for process and power generation. But a like hookup could be used where only process steam is needed.

Required volume of the accumulator can be computed using the properties of steam and water, assuming the vessel to be 90% full of hot water.

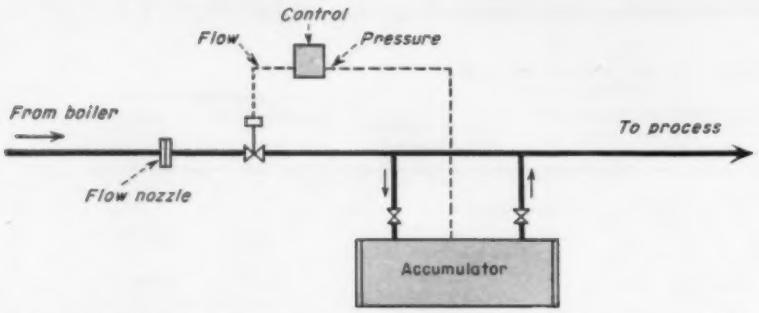
H B WAYNE *Brooklyn, N. Y.*



More on next page

More PLANT PROBLEMS

Begins on page 142



FLOW AND DURATION of steam-demand fluctuations determine accumulator size, not boiler capacity. Accumulator is sized on the basis of required storage capacity and pressure range. For best efficiency, the range between boiler and accumulator pressure should be as large as possible.

For accurate sizing, the steam demand, average steam flow and hourly steam use of the machines must be known. In stocking mills, steam cures the hosiery when nylon is placed on leg-shaped forms. High-temperature steam is first admitted, next the steam temperature is reduced, the stockings taking a permanent set.

This usually requires large quantities of 35-psig steam for several seconds; then demand is zero as the operators remove the formed hose. After the first cycle, machines run as much as 10 to 15 seconds apart. This permits *FG* to disregard maximum calculated flow and use a 10-second average flow instead.

Except for morning and noon starting cycles, which can be staggered, it is not likely that more than half the machines will start within a 2-second period. Tests show that only 25% of the connected machines start within two seconds of each other.

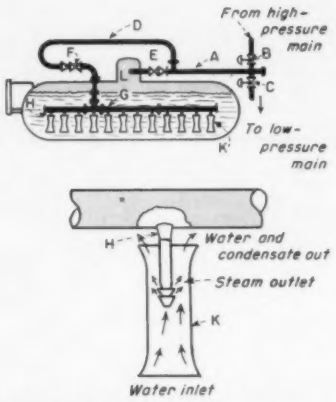
Over-all steam demand falls to 60% of the gross figure. *FG* should keep line pressure at 40 to 45 psig for machines using 35-psig steam. Limit pressure drop to one psi per 100 ft of pipe. Smaller pipe sizes tend to reduce accumulator efficiency. While larger pipes have slightly higher first costs, pressure loss is lower and there is more steam in the pipes to meet peak starting loads.

Sketch shows how accumulator should be hooked up for this service. Where large single-seated reducing valves are used to limit pressure to 45 psig, the severe service may wire-draw the seats. Valves must be carefully chosen so they open and close with sufficient speed to follow load changes.

L W FITZPATRICK

Jefferson City, Mo.

Turn to page 146 for answers to Question No. 2 on grounding neutrals



CHIEF APPLICATION of the type of accumulator *FG* is considering is between the boiler and process units. The boiler operates at a higher pressure than the process equipment. The accumulator stores heat energy in a large quantity of water at saturation temperature.

FG should recognize that boiler capacity does not affect the degree or amount of smoothing of steam peaks obtained with an accumulator. Size and rating of the accumulator determine the results obtained at process end of plant.

Sketch shows a typical accumulator and its connected piping. Since it isn't practical to charge and discharge an accumulator simultaneously, one pipe is sufficient to feed high-pressure steam to the unit, or pass steam to the low-pressure main.

Steam from the high-pressure main

(*Continued on page* 218)

YOUR NEW PROBLEMS FOR JUNE

1 How can we stop stack corrosion?

Photo shows how our 15-yr-old stack collapsed during removal for replacement. Checks showed the ¼-in. mild-steel plates had thinned to 1/16 in.

We could have avoided the inconvenience of the collapse by removing stack three years sooner. Or we could have left it in service until its own weight caused it to fall. Which is more economical?

Or is it better to (1) coat stack interior (2) use some other method for preventing corrosion from flue gas?—*CW*

2 How is heating system balanced best?

We have a 20-story apartment building with a forced hot-water heating system. Some apartments are too hot, some too cold. Hot-water temperature and flow are more than adequate and radiators appear in working order.

I think the system needs rebalancing. Each riser has a balancing valve at its heel and every convector has a shutoff valve in its supply and return.

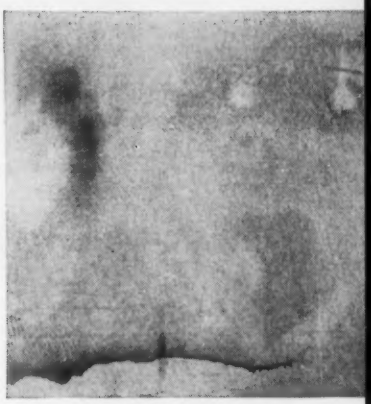
What is the best procedure for balancing flow in this plant? How can we check to see that flow is right in each riser?—*WS*

Will you help readers who sent us problems? Extra pay for photos or sketches.

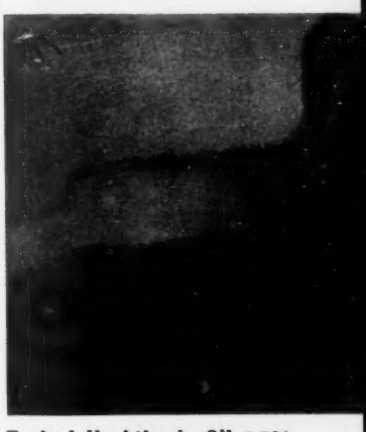
HOW NEW SOLNUS OILS HELP MAKE AIR COMPRESSORS FIRE SAFE

Actual photographs show amounts of carbon residue left after dropping equal quantities of Solnus and two other oils on steel plates and baking in a closed oven at 500°F for 24 hours. The three oils all had viscosities of 300 SUS at 100°F.

SEE HOW CLEAN SOLNUS LEAVES HOT METAL



New SOLNUS Oil 0.9%



Typical Naphthenic Oil 5.5%

Typical Paraffinic Oil 9.0%

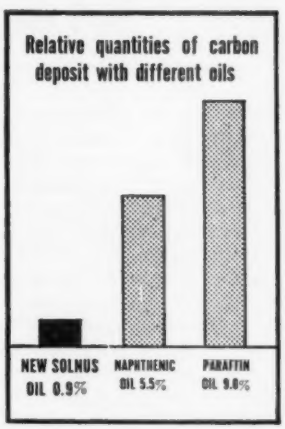
The biggest cause of air compressor fires or explosions is carbon formation on valves and in discharge lines. The best way to avoid these risks is to use the lubricating oil having the lowest tendency to form carbon.

New Solnus Oils have been proved ideal for air compressor use. The minute amounts of carbon that will form are of a fluffy nature; so they blow off quickly and do not build up. Thus the danger of fire or explosion is largely removed.

Solnus Oils have other important advantages, too. Your compressors need cleaning less frequently. This reduces maintenance costs. Shutdowns are less likely. Plant efficiency is increased.

Solnus Oils are also ideal for circulating systems, hydraulic systems, gear boxes, and general lubrication of your industrial equipment. They simplify your storage problems by doing with *one oil* many jobs that would otherwise require *several*. Combine their ability to protect metal parts against corrosion, their resistance to oxidation, and their moderate price and you see how Solnus Oils give you "more lubrication per dollar."

Let us send you our complete technical bulletin on Solnus Oils. Just write Dept. P-6.



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More PLANT PROBLEMS

Begins on page 142

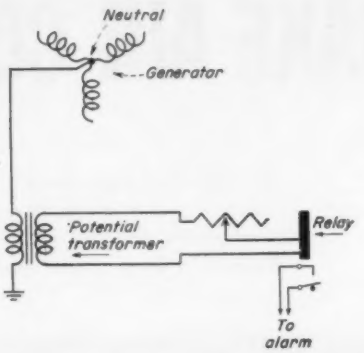
Should we ground plant neutrals?

HERE ARE THE FACTS: We're expanding our industrial plant's electrical system and would like your readers' opinions on grounding neutrals.

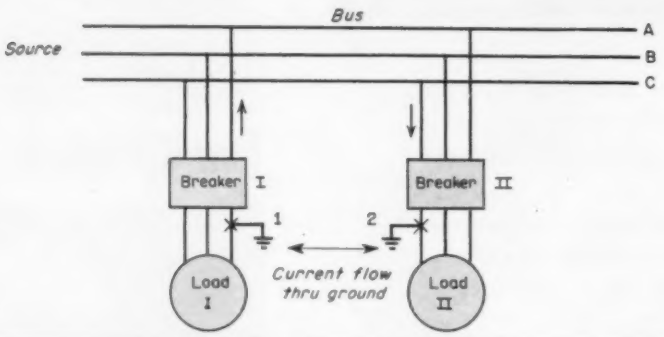
Should neutrals on transformers and generators be grounded? Why? What are the advantages? Many plants operate for years without grounding and never seem to get into trouble.

Where and at what voltage levels should we ground? Can any parts of the system be left without grounds? What kinds of overcurrent devices are needed? How can we protect motors?

When should we consider resistance grounding? What is the best detector for an ungrounded system? —*SJ, March Power*



Here are the answers



FAULT	GROUNDED	UNGROUNDED
Ground at 1 in phase A	Cb I opens to clear bus	Nothing happens
Ground later at 2 on phase C	Cb II opens to clear bus	Both I and II open

MODERN PRACTICE generally grounds feeder and distribution circuits. A grounded neutral gives greater safety, reduced maintenance, and sometimes greater reliability.

Voltage from line to ground in ungrounded and grounded neutral systems is normally line voltage ÷ 1.73. But a ground in an ungrounded system may produce voltages several times the line-to-ground value during switching or arc restriking. This overvoltage can damage equipment or cause fires.

Maintenance crew can usually locate grounds in an ungrounded system. But this takes time. With an ungrounded system you can choose when you want to interrupt service to locate a ground. On a grounded system the circuit is automatically interrupted when a ground occurs. Though a long search is not needed, service may be interrupted at an inconvenient time. But, as sketch shows, two grounds in an ungrounded system cut out two services. So choice of one system over another depends on how much reliability is needed and how quickly you can locate a ground when it occurs.

The Code requires that overcurrent devices for motors in grounded systems be placed in the ungrounded conductors. This requirement can lead to a large amount of work in converting an ungrounded system to a grounded one, especially if the plant has a large number of motors. *SJ* will run into a number of problems in converting a grounded system to an ungrounded one because older plants have delta-connected transformers for distribution.

The grounded system is best for a new section of a plant, but economics and reliability of the older section dictate whether a change is needed.

R P Schiller *Woodstown, N. J.*

SHUTDOWN of one unit in our mills affects the entire production process. So we've used ungrounded systems for years. But in the last few years we've swung to the viewpoint that elimination of faults caused by transient overvoltages on ungrounded systems makes grounding desirable.

Other advantages include greater safety, better overcurrent protection and improved lightning protection. Eliminating overvoltages means lower operating and maintenance costs and greater reliability. We find multiple ground faults are common in ungrounded-neu-

(*Continued on page 222*)

GROUNDS ARE INFREQUENT. A check of three large plants, having a total of more than 24,500 motors, their associated control equipment and miles of low-voltage circuits, showed one plant averaging one ground fault per day. The others had one or two each week.

Main cause of ground faults is building and machine vibration. Grounding the neutral will not alter these conditions. Grounds in grounded-neutral systems stop production until repairs are made. Faults on ungrounded systems allow production to continue while the fault is located and repaired during normal shutdowns.

The argument for grounding low-voltage systems is to reduce overvoltage failures in motors and equipment. These come from lightning, intermittent grounds on ungrounded-neutral systems or from resonance effects.

New unit substations provide secondary wye connections at small cost. Grounded-neutral systems limit motor and other equipment failures. Less time is needed to locate grounds. There are fewer production interruptions and less danger to personnel.

Ground detectors are a must with ungrounded systems. Electrostatic types requiring full line voltage on the operating panel are undesirable. Sketch shows a practical detector for a plant with an ungrounded system.

L W Fitzpatrick *Jefferson City, Mo.*

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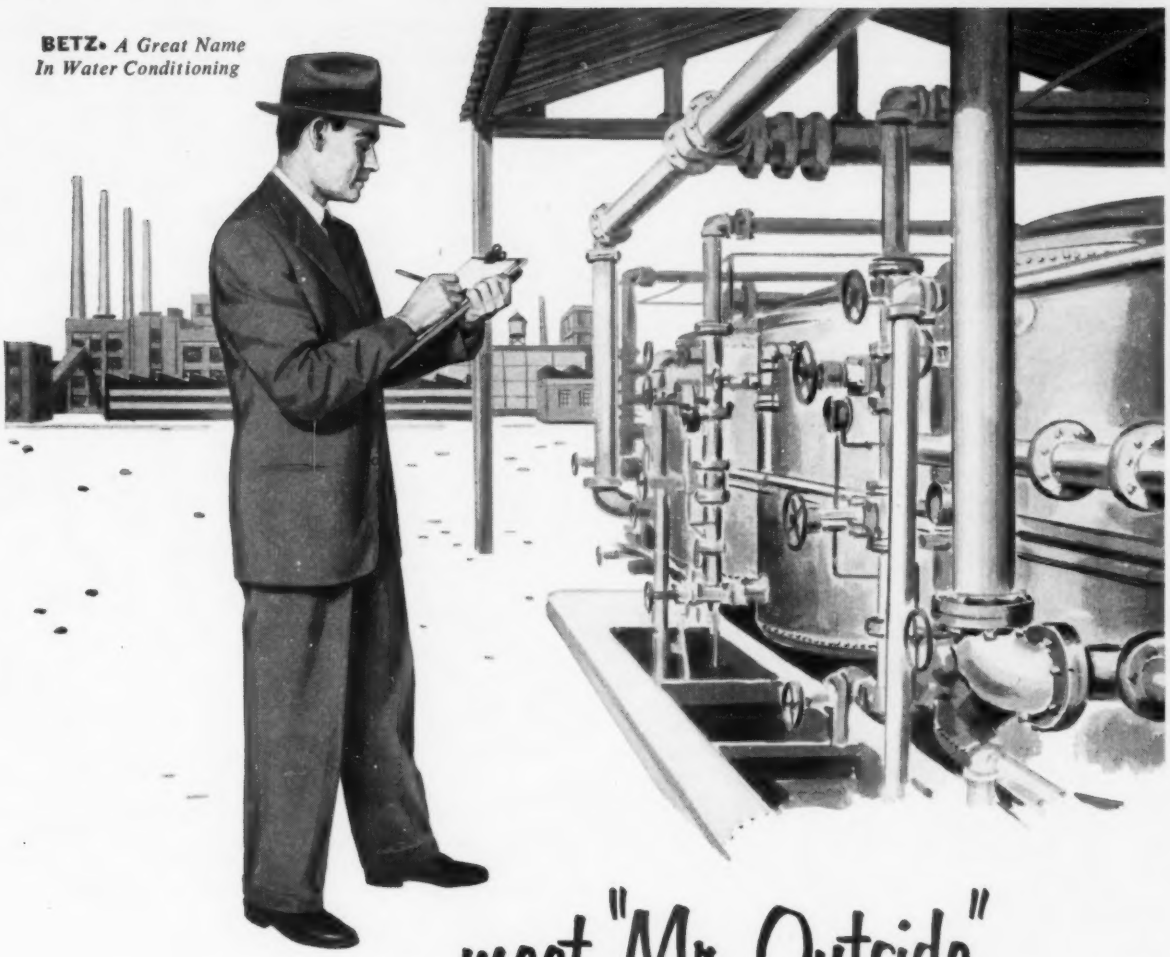

. . . meet "Mr. Outside"

■ Unusual title for a professional engineer? Perhaps so. Here's what we mean.

Actually, our activities are by no means limited to the regular chemical conditioning and control of boiler and cooling water. Take the Betz Consulting Division, for example.

Here is an entirely separate unit, staffed with chemical, mechanical and sanitary engineers, qualified through years of experience to make unbiased recommendations for the solution of problems involving the *external* conditioning of industrial and municipal water supplies . . . and for treatment and disposal of industrial wastes.

Many, if not most water or waste treatment problems are individual in character. They require study by *specialists* in order to reach a solution that is both operationally and economically sound. Such studies made by the staff of the Betz Consulting Division have saved much effort and productive time for hundreds of plants across industry. How can this important Division of Betz *completely-integrated* water conditioning service assist you?

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CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

ARGUMENTS

Want to start something? Like to have your say about any article in Power? This department invites all comments

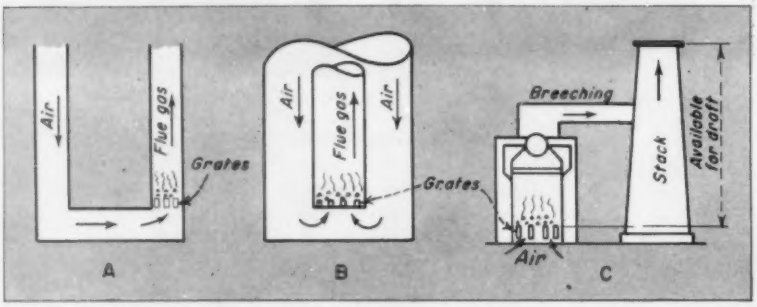


Figure that a chimney is like a U tube

ACCORDING TO F A BERGEY, March "Arguments," you should calculate height of a chimney for estimating draft by measuring from the point where the lowest absolute gas pressure exists. For a 20,000-lb-per-hr boiler, he says this may be 15 feet or more above the grate line, where breeching connects to chimney.

I disagree with Bergey.

A chimney functions in the same manner as a U tube used for measuring pressures in a gas stream. The difference in unit pressure between atmospheric air and the gas is due to the difference in density of the fluids.

Combustion gas leaving a boiler is usually higher in temperature than the atmospheric air. The gas has a greater specific volume and, therefore, a lower density. The difference in density serves as a unit driving force that permits the colder air to move in, displacing the hotter gas.

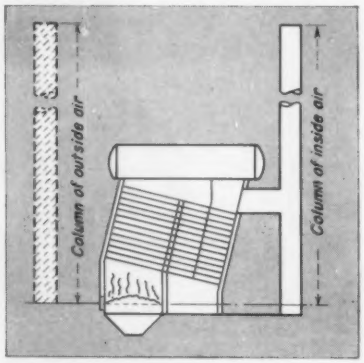
Increasing chimney height increases the total driving force. Friction losses make the net increase less than theoretical increase would be.

Sketch *A* shows a U-tube arrangement of two stacks connected at their bases. Heat of combustion causes air flow down cool stack and gas flow up heated stack.

Sketch *B* shows a conventional design having air stack around the gas stack, producing same results as *A*.

Sketch *C* is a typical furnace and stack arrangement, essentially the same as *B*. Total available driving force of the cold air depends on the distance from top of grates to top of stack. This is the correct way to calculate draft a chimney will produce.

H B WAYNE *Brooklyn, N. Y.*



Measure stack height from grate line

REGARDING THE QUESTION raised by F A Bergey in the March issue, as to the datum line for calculating stack height, it does seem strange that there should be a difference of opinion.

Let's consider a cold furnace with the internal atmosphere in absolute balance with a column of equal height outdoors (sketch). Under such conditions there is no draft.

Now a draft is caused primarily by the difference in temperature between the stack gas and the outside air, with a minor disturbance arising from a difference in chemical composition between pure air and products of combustion.

As the fire is started, the furnace gas gets warmer and warmer and, hence, correspondingly lighter all the way from grate to top of stack. All the hot gas has an influence on the draft, stack and furnace walls.

In fact, height of the furnace produces more draft than an equivalent height of stack. If the datum line is assumed as being at the breeching instead of at grate line, the computations of chimney height will indeed be in error.

A DI LORENZO *Brooklyn, N. Y.*

Marmy takes the wrong tack

I SURE ENJOYED the Marmaduke story about "The Boiling Coffee Pot," March POWER, but I am sorry to report that our hero missed the boat when he got out of the field of his estimable engineering experience.

I yield to no man in my admiration of Marmaduke Surfaceblow as a marine engineer, but when it comes to sailing ships he must be a babe in arms, else he would hardly have been guilty of saying, "You have to tack when sailing before the wind."

Please tell him, as tactfully as possible, that you have to tack when sailing *against* the wind, not *with* it.

JOE MORAN *Philadelphia, Pa.*

EDITOR'S NOTE: *Reader Moran is right. Fact is, Marmy did say* against *the wind, but we got it balled up here in the office.*

What's best emergency electric service?

IN OUR LARGE TYPEWRITER PLANT we buy our electricity, but we have had one power failure and want to be prepared for the next one. We figure that a small diesel, gasoline or steam turbine-generator of about 100 kw might solve our problem.

We think these areas should be supplied with electricity in an emergency: (1) lights for exits, aisles, etc (2) supply air for sprinkler system (3) one elevator (4) plant hospital (5) air for boiler stokers (6) flood lights for building (7) auto-call system (8) fire-alarm signals (9) refrigeration in cafeteria.

Has any reader an opinion on which type generating unit would be best? Have we missed any vital services that should be maintained during the course of an emergency situation?

PAUL TANASI *Hartford, Conn.*

Somebody's hat is on backward

AS LONG AS you were spending the money for a fancy 4-color cover for the March issue, you might have spent another dime on a phone call to find out which way to wear a safety hat.

Didn't anybody ever tell you that you always wear the wide brim in the back?

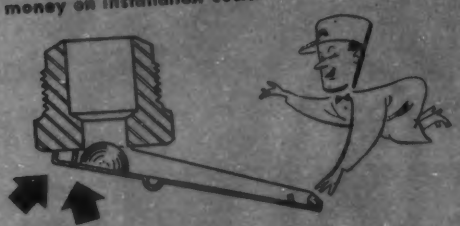
HERMAN PHELPS *New York, N. Y.*

EDITOR'S NOTE: *Has Reader Phelps got brims on the brain? What do you other authorities think?*

How Armstrong Traps Save you Money

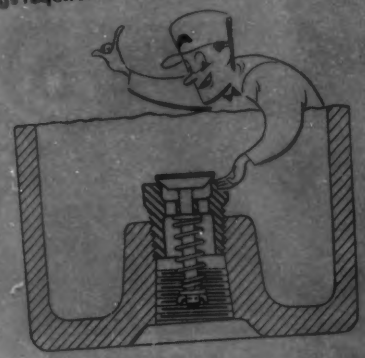
Choice of body styles saves money on installation costs.

Hardened, ground and lapped valve and seat; stainless steel mechanism resists wear and corrosion—saves money on maintenance.



Two phase leverage means higher capacity in a smaller trap. Armstrong traps have optimum relation between leverage, valve travel, bucket weight, capacity and overall size.

This internal check valve saves labor and fittings required to install regular check valve.



This trap with built-in strainer costs less than separate trap and strainer—requires less labor and fittings to install.

Get the full facts on money-saving Armstrong traps. Send for free Catalog J. Clip and mail coupon today.

ARMSTRONG STEAM TRAPS

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

Gentlemen: Please send me a free copy of Catalog J, The Armstrong Steam Trap Book.

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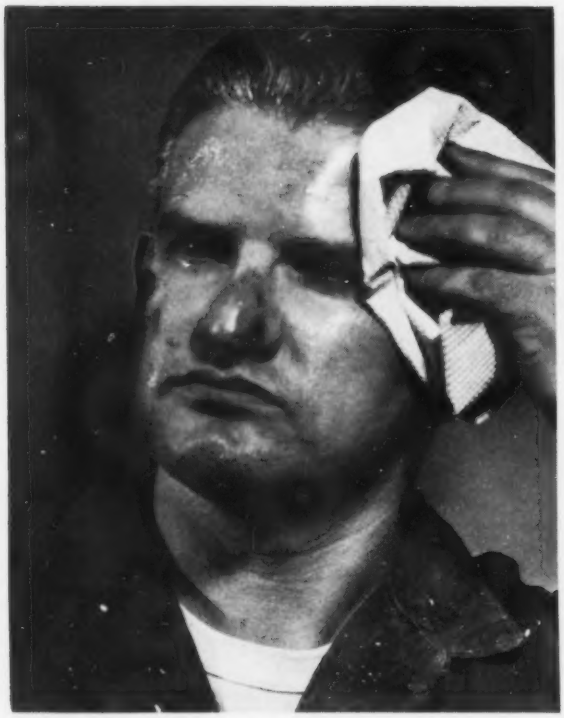


WIPING FACE AND HANDS accounts for 60% of the wiping done in industry. This paper is sanitary and also saves money

MOTOR is quickly cleaned of sawdust and grease with this wiper. Paper's embossed surface and strength make it ideal

SOLVENT used for cleaning drill press does not disintegrate this paper during normal use as it is chemically treated

CONTROL BOARD for high-pressure boiler is cleaned by Bill Devine, the boiler operator. No scratching with this wiper

COAL STOKERS in boiler room cleaned by water tender, Clent Robertson. On this job, paper is used with cleaning solution

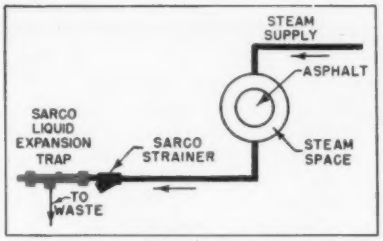
HOW TO get the most from your wiping dollar

Here's a tip to help you cut down on industrial wiping costs and reduce employe accident rate. Power plants and industry in general can now use a brand-new disposable paper wiper that permits a new approach to such problems as high unit cost, expensive handling, erratic performance, shrinkage and laundry loss caused by other wipers.

New paper wiper has many advantages for workers. There's no danger of paper containing steel shavings, filings or chips from a previous job that cause cuts. Each clean sheet is ideal for wiping hands and face, which accounts for 60% of all wiping done in industry. Wiping paper is chemically treated for greater wet-strength and can be used with common industrial solvents. Sheets come in box with "pop-up" feature, making it handy and sanitary.

Photos taken at Chester plant of Philadelphia Electric Company. Courtesy, Scott Paper Company

Misused steam plays havoc with production schedules and costs



Sarco Liquid Expansion Traps permit use of sensible heat of condensate.

How Seneca Petroleum Cut Monthly Steam Consumption 429,000 lbs.

Seneca Petroleum of Illinois pumps asphalt Flux-oil to its 14 steam-heated storage tanks via a steam-jacketed line from a nearby refinery.

The traps which were draining condensate on tanks and flow lines were doing an adequate job. However, since they were discharging at about steam temperature and the condensate was going to waste, Seneca's plant manager decided he could save additional steam by installing Sarco Liquid Expansion Traps.

These traps discharge at *adjustable temperatures below 212° F*, permit the use of the condensate's sensible heat. Although another 100,000 gallon tank was subsequently installed, Seneca was able to reduce monthly steam consumption from 2,429,000 lbs to 2,000,000 lbs.

This is but another example of savings effected by proper steam utilization.

Sarco Liquid Expansion Thermostatic Trap

Discharges condensate at pre-set temperatures below 212° F. Withstands waterhammer, pressure pulsations and superheat. Freeze-proof. *Write for Bulletin 260.*

Use Steam Right

1. To prevent production delays
2. To improve product quality
3. To maintain desired output
4. To reduce labor and steam costs

IN YOUR processing operations, are you up against troubles such as slow-ups, uneven or inadequate heating, poor temperature control—resulting in reduced output, lowered product quality and increased costs?

You may suspect that your equipment is at fault. But process heating headaches often are due to ineffective utilization of steam. The wrong type trap can cause condensate to waterlog equipment. Improper air-venting can reduce the rate of heat transfer by as much as 11%. Manual temperature control may prove erratic, affect product quality, increase production costs.

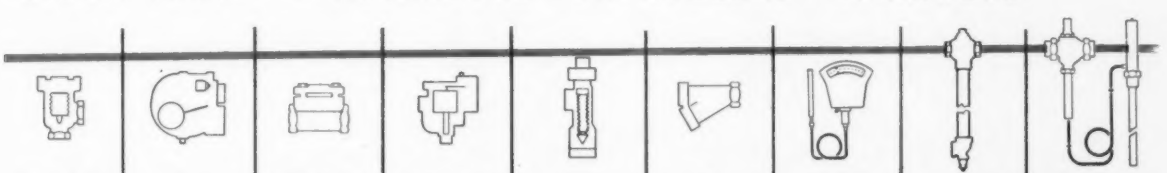
If your plant is suffering from any of these production handicaps, Sarco can help you. Sarco has a wealth of practical experience in the process industries to put to work for you. Plant after plant, with Sarco help, has licked these problems through simple, inexpensive changes. The results have been: increased output, improved product quality uniformly maintained, lower production costs.

Engineering Service: Our engineering service is yours for the asking. Call our local representative, or, write today for case histories describing how other plants in your field have solved similar problems through the proper application of steam traps and inexpensive temperature controls. Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

SARCO

improves product quality and output

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS



Thermostatic Steam Traps | Float-Thermostatic Steam Traps | Thermodynamic Steam Traps | Camlift Bucket Steam Traps | Liquid Expansion Steam Traps | Strainers | Electric Temperature Controllers | Water Blenders | Self-Operated Temperature Controllers

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

I: Burning hydrogen with pure oxygen

	$2H + O = H_2O$
Parts by weight	2 + 16 = 18
Pounds	1 + 8 = 9

II: More nitrogen than oxygen in air

	Oxygen	Nitrogen	Air
Parts by weight	23 +	77	= 100
Lb per lb O	1.00 +	3.35	= 4.35
Lb per 8 lb O	8.00 +	26.8	= 34.8

III: Weight of oxygen, nitrogen, air and products for one pound of hydrogen

	Supply				Product				
	Hydrogen	Oxygen	Nitrogen	Air	H_2O	Oxygen	Nitrogen	Flue Gas	Dry Flue Gas
CASE 1:									
No excess air	1	8	26.8	34.8	9	0	26.8	35.8	26.8
CASE 2:									
Theoretical air	1	8	26.8	34.8	9	0	26.8	35.8	26.8
100% excess air	0	8	26.8	34.8	0	8	26.8	34.8	34.8
Total	1	16	53.6	69.6	9	8	53.6	70.6	61.6
CASE 3:									
Theoretical air	1	8	26.8	34.8	9	0	26.8	35.8	26.8
50% excess air	0	4	13.4	17.4	0	4	13.4	17.4	17.4
Total	1	12	40.2	52.2	9	4	40.2	53.2	44.2

Combustion Facts-4:

Hydrogen burned in air

► EXCEPT PERHAPS in a chemical plant, pure hydrogen is practically never burned to generate steam. In spite of this fact every power engineer should understand what happens when pure hydrogen is burned. If he doesn't, he will never quite understand what happens when he burns commercial gases (city gas, producer gas, coke oven gas and natural gas) all of which contain much hydrogen either in the combined or the free form. Also, there is some hydrogen in coal and much in boiler oil.

Hydrogen is the lightest gas (also the lightest element). It takes 188 cu ft of hydrogen to weigh one pound. However, in this article we won't consider volumes but will deal with pounds only, just as we did last month when studying the burning of carbon.

Table I shows that two atoms of hydrogen burn or combine with one of oxygen to give one molecule of H_2O (plain water). Because of the heat released by the combustion, this H_2O is always in the form of superheated steam from the moment of its birth. Later it may, or may not, condense to liquid water, depending on the conditions of combustion and heat transfer.

Since we are dealing here only with weight we need pay no attention to the condition of the H_2O produced.

For convenience the first two lines of Table II repeat those of last month. We see that, by weight, air is 23 parts oxygen to 77 parts of nitrogen. We see also that every pound of oxygen burned carries with it into the furnace 3.35 lb of "free-riding" nitrogen.

Since it takes 8 lb of oxygen to burn one pound of hydrogen the least air to burn one pound of hydrogen is 34.8 lb, containing 8 lb of oxygen and 26.8 of free-riding nitrogen. I call it free riding because the nitrogen takes no chemical part in the combustion. Yet it does get heated up and is finally thrown to waste up the stack with some of this heat left in it. This wastes part of the money spent for fuel.

EFFECT OF EXCESS AIR

In Case 1 note that the flue-gas weight of 35.8 lb equals the total weight of air and hydrogen fed to the furnace. Weight of *dry* flue gas is nine pounds less because we subtract the 9 lb of water produced.

Consider next Case 2 where the air supplied for combustion is double that required theoretically. Here the first line merely repeats Case 1. The second line carries through for the 100% of excess air. Note that the materials in this second line play no chemical part in the combustion, so the right side of the equation on this line is the same as the left.

Compare the totals in Case 2 with those in Case 1. Note that the weights of both air and flue gas have practically doubled. This means that the stack losses in the hot gas will be practically doubled.

Case 3 is a similar tabulation for a case where the excess air is 50%. Note the reduction in weight of flue gas. This will greatly reduce the stack loss.

for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

JENKINS

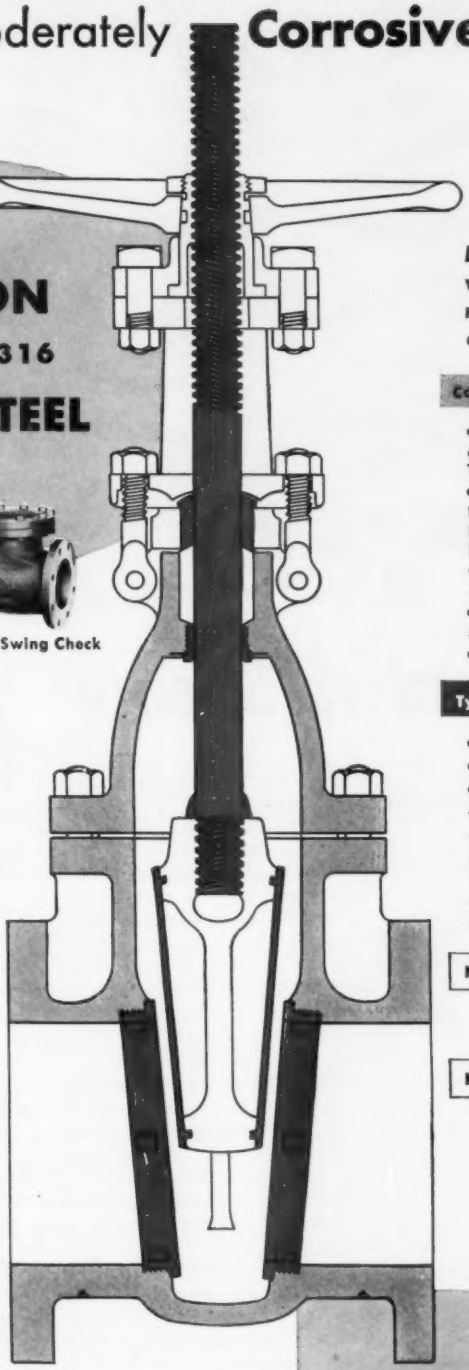
NICKEL IRON

Valves with Type 316

STAINLESS STEEL

Trim

Fig. 2624 Swing Check



Every part in contact with fluid is the right metal to block corrosion and beat wear.

Cast NICKEL IRON

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2″ to 4″ sizes.
- **WEDGE** In 10″ to 24″ sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10″ to 24″ sizes.
- SEAT RINGS
- DISC and HANGER in Gate Valve

NI-RESIST Type No. 2

- WEDGE of I-beam structure is solid NI-RESIST in 2″ to 8″ sizes.

PRESSURE RATINGS

2″ to 12″—200 lbs. O.W.G.
14″ to 24″—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

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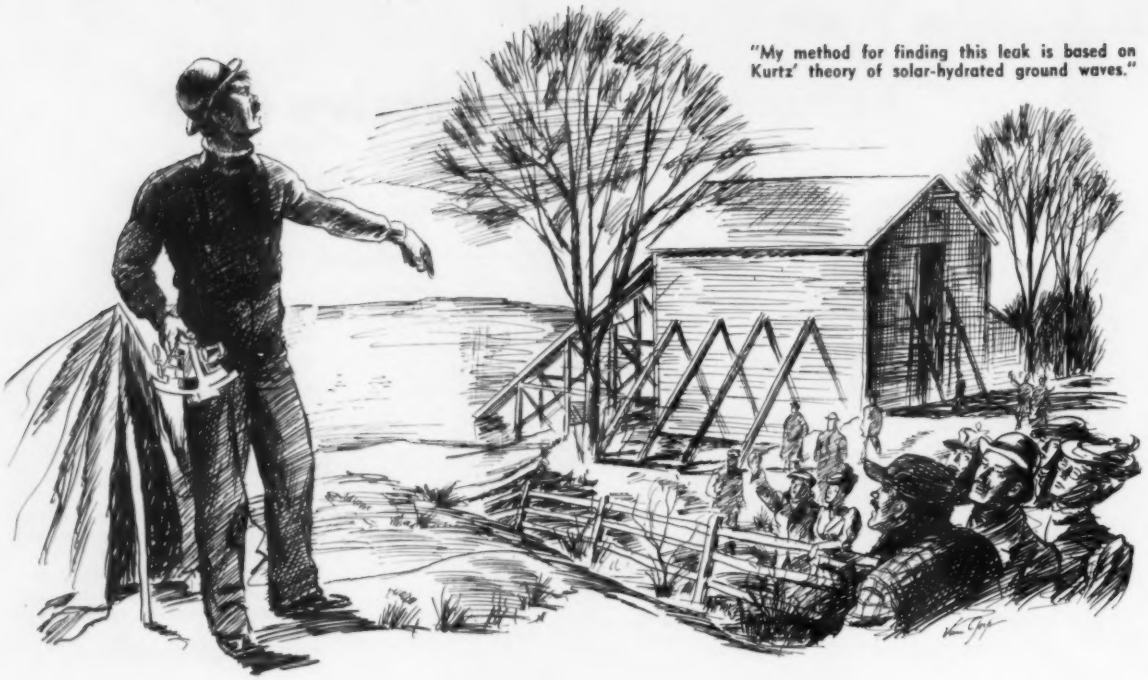
LOOK FOR THE DIAMOND MARK

VALVES

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros.



"My method for finding this leak is based on Kurtz' theory of solar-hydrated ground waves."

Marmy Murders Science

► "I'LL FIND THAT LEAK in your buried pipe and all I need is a ship's sextant, a plumb line, a galvanometer and a copy of Kurtz' *Theory of Solar-Hydrated Ground Waves*," roared Marmaduke Surfaceblow at the Bent Propeller Bar last night. But let's start at the beginning.

The old consulting engineer's office above O'Houlihan's Machine Shop & Engine Works was locked, so I hotfooted over to the B-P bar. That place was packed, and there was Marmy, firmly anchored to his end of the crowded bar. Above the loud conversations could be heard the clanking glasses and raucous guffaws of the salty inmates.

I recognized a group of engineers from the *SS United States* at one table, Italian seafarers from the *Conti de Savoy* at another, Spaniards from the *SS Trinidad* at a third, and a table crowded with limeys from the tramp ship *SS Liverpool* down the street.

Scattered about were the usual waterfront characters dressed in an assortment of foul-weather gear. They were off tugs and barges; some were stevedores, others, stationary engineers from neighborhood plants. The sawdust-covered floor, the brightly polished bent propeller on the long bottle-lined back bar, white aproned bartenders scooting between tables with trays of glasses and the babble of foreign tongues made this a perfect international setting for our cantankerous hero.

Everyone but Marmaduke seemed to be drinking and gabbing. As he leaned his large hulk on the bar, his huge paw maintained a stranglehold on a bottle of Sandpaper Gin. The old gray bowler was cocked forward on his dome and, as usual, he seemed deep in thought. No doubt his amazing mind was grappling with some complex scientific theory too intricate for ordinary mortals like us to understand.

Suddenly Marmy straightened up, turned his back to the bar, hooked his thumbs into the armpits of his checkered vest, then roared, "BILGEWATER on tracing out piping leaks with radioactive isotopes! I knocked off those jobs years before the Geiger counter was even thought of."

That did it. The gale from that blast swept through the place like a Nor'-western in the Bay of Fundy. That foghorn-voice rattled everything including the bent propeller on the back bar. Conversation stopped instantly. All eyes turned upon our hero. Marmy surveyed his audience calmly. Neither Mohammed, Moses nor Genghis Khan ever received more attention or respect when addressing the multitudes. Satisfied he had the floor, Marmy blasted away.

"Back in '19 I stopped off between ships to do some trouble shooting for my friend O'Houlihan here in New York. One afternoon we got a long-distance call from Isambard Gooch of Glen Falls in northern New York. He said they needed someone to find a leak in a buried steam line that O'Houlihan had installed a few years before.

"'I'll find that leak,' I told him, 'but besides expenses and a hundred dollars, I'll need a ship's sextant, a plumb line, a galvanometer and a twelve-foot-square piece of canvas. And, you'll have to lay 12-gage copperwire directly above that buried pipe and connect one end to the boiler, the other to the engine.

"'Do you want bare or insulated copper wire?' Gooch asked innocently.

"'Is your steam pipe bare or insulated?' I shot back.

"'Bare,' he answered.

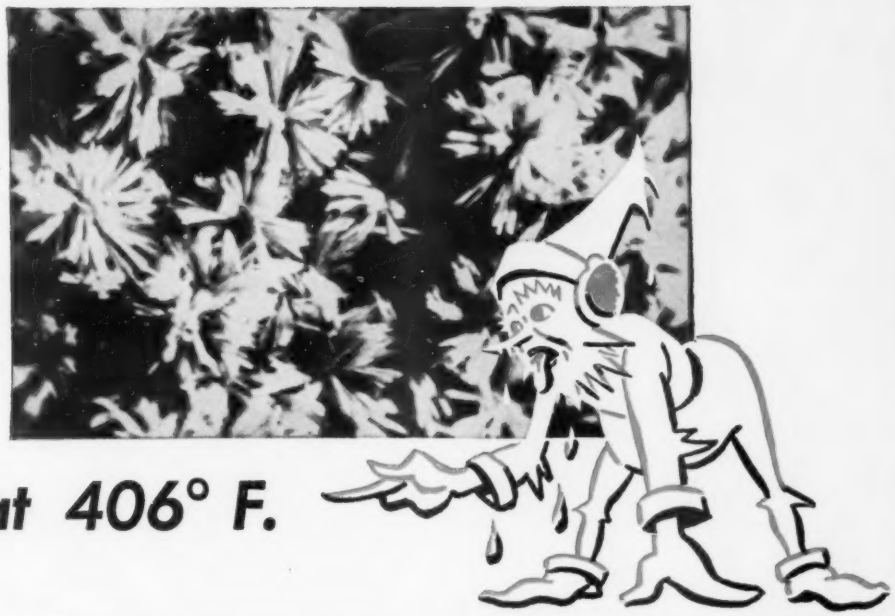
"'OK then, use bare wire,' I informed him. Gooch agreed to have everything on hand and I promised to be there on the noon train.

"Later, I learned that he owned the Deuterman Ice Co. Their product was artificial and natural ice. The ancient power plant had a 1000-hp Parker water-tube boiler, supplying an old uniflow steam engine that drove a DeLaVergne horizontal ammonia compressor. An old Rumeli-Dawley corliss drove a second compressor for making ice.

"Natural ice was harvested from a pond used also for condensing water. The small O'Houlihan donkey engine was down at the pond and was con-

(*Continued on page* 244)

JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

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"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.

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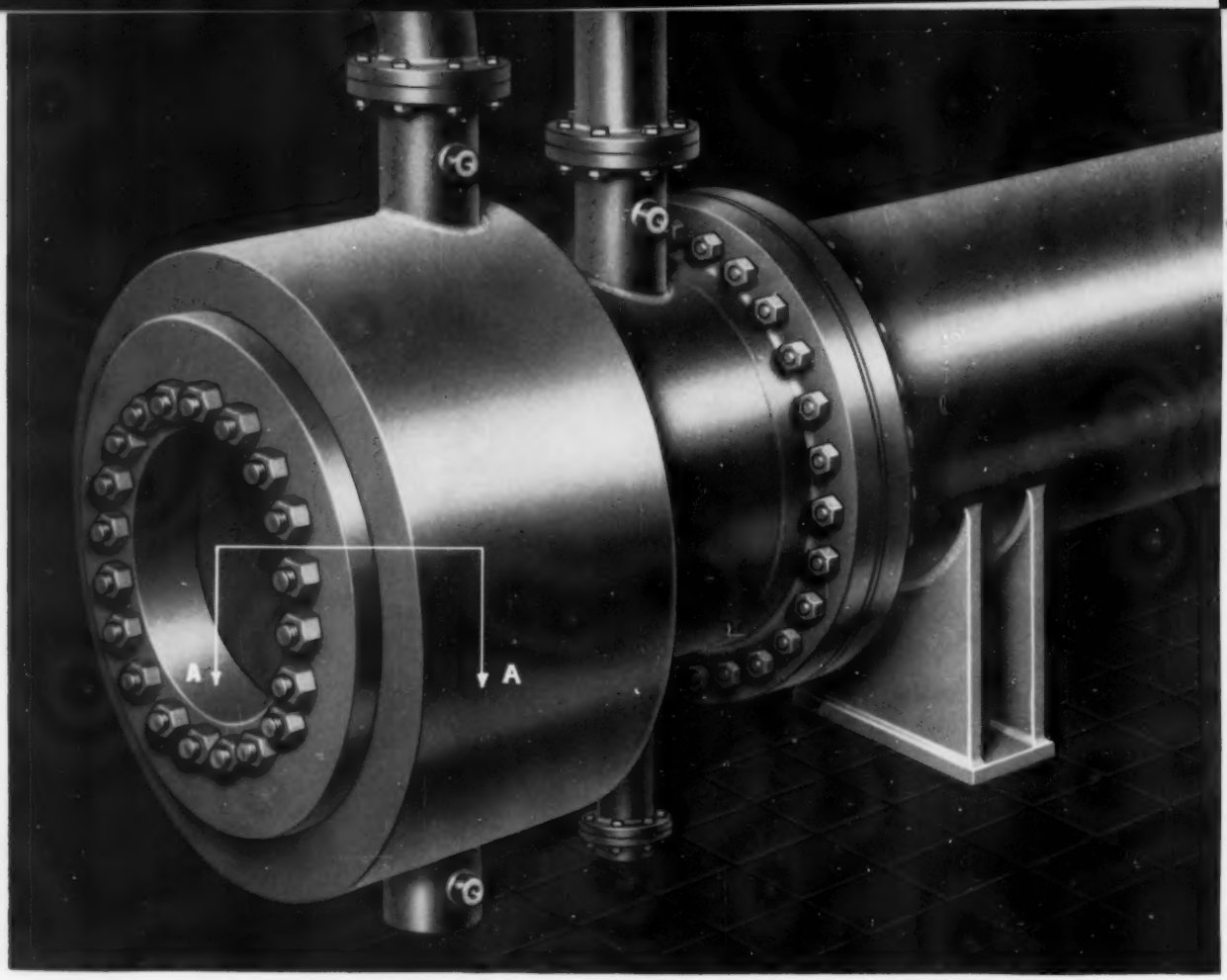


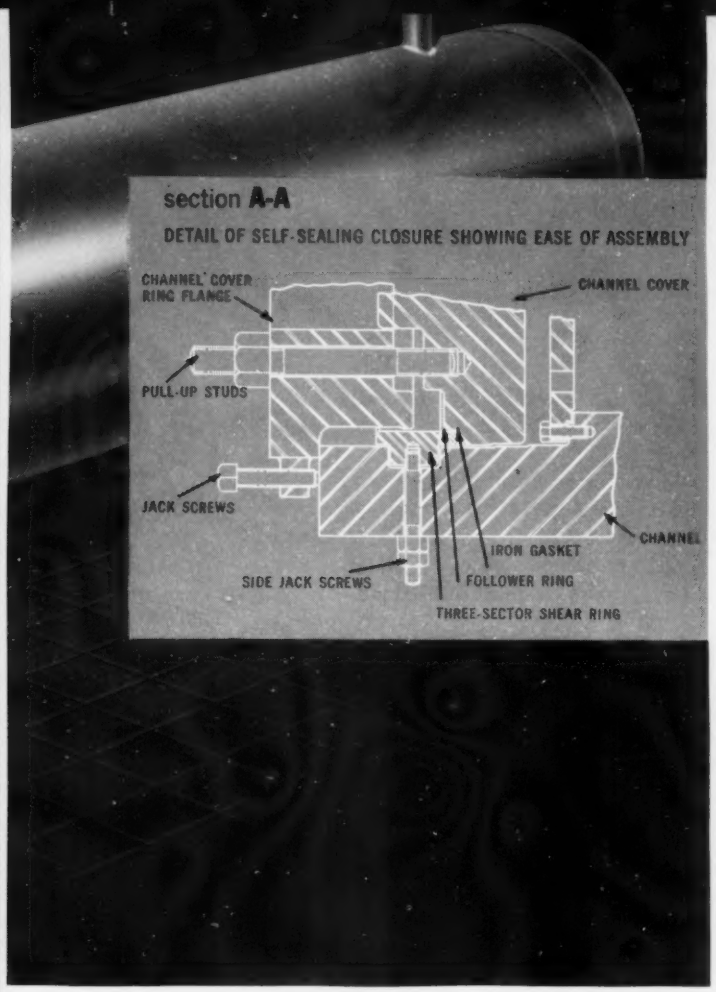
A.O.Smith Feed Water Heaters selected for one of newest Midwest high-efficiency power plants

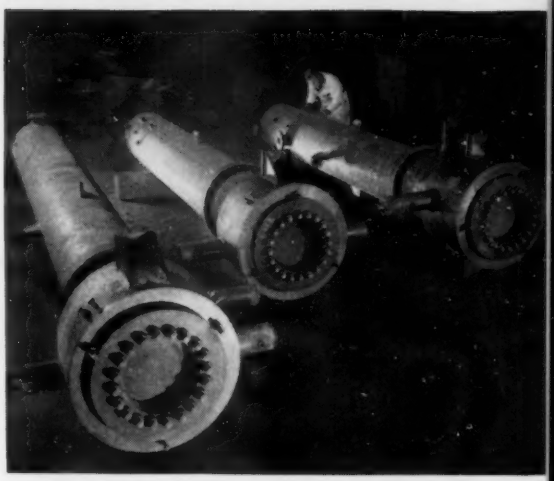
Six high-pressure Feed Water Heaters, designed with desuperheating and drain cooling sections, were built, installed and are on stream in this new 1800-psi steam power plant on the shore of Lake Michigan.

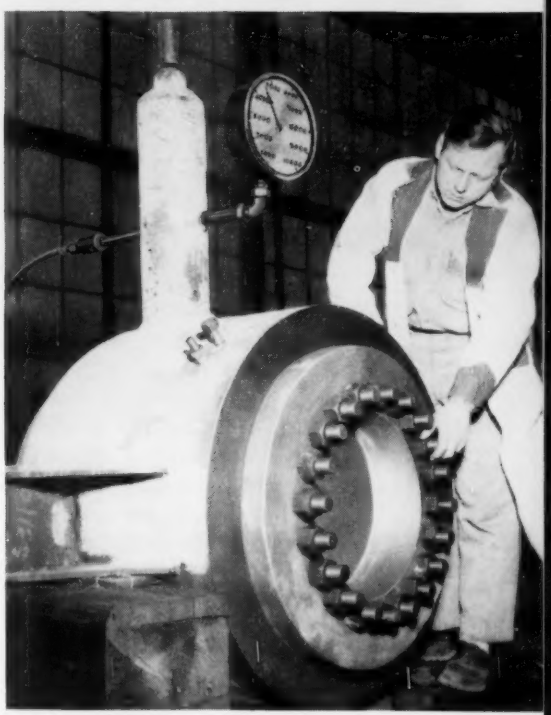
In performance, they fully justify their selection for this demanding service. We are now manufacturing an order for six more identical units for a duplicate addition to this plant.

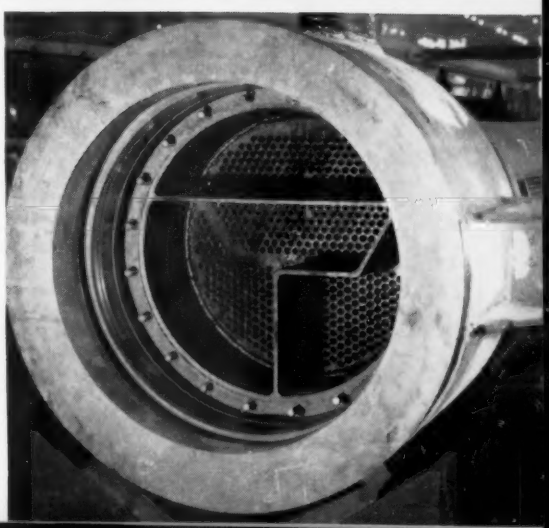
Since specifications of 1,000 to 10,000 psi are run-of-mill in our vessel and exchanger shops, we are uniquely fitted and equipped to satisfy the current requirements of power-plant designers.

We invite you to bring your heat exchanger problems to A. O. Smith. You'll profit from the services of one of the finest thermal design groups in this country.









top right: Three of the six high-pressure feed water heaters undergo final inspection before shipment for installation in the new power plant. They are designed for 2400 psi on the tube side.

right: Testing the end closure and channel of one of the feed water heaters at 4800 psi. The closure is self-sealing.

bottom: View of interior of channel shows tube sheet, pass plates and recess for shear ring of self-sealing closure.

Through research A.O. Smith *. . . a better way*

A.O.Smith
CORPORATION

Process Equipment Division
Milwaukee 1, Wisconsin

International Division: Milwaukee 1

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

Private atom plants got another boost recently when a group of 26 industrial firms headed by Detroit Edison and Dow Chemical agreed to put $2.3 million into a mock-up of an advanced nuclear power plant.

Meanwhile, the Congressional Joint Committee on Atomic Energy has brought in a complete revision of the 1946 Atomic Energy Act. This would permit private industry to own and operate nuclear plants, under AEC license, and allow some Presidential discretion on exchange of information with friendly nations. The bill carries a priority tag, but faces the usual run of hearings and debate.

Petroleum products from coal will be turned out on a full-scale commercial basis this summer in a plant built by M W Kellogg for the Union of South Africa. Operated by South African Coal, Oil and Gas Corp (Sasol), installation will produce 55 million gal of gasoline, 4.5 million gal of diesel fuel and more than one million gal of fuel oil annually. Built atop a vast coal field, Sasol will, it is estimated, convert one ton of coal costing $0.84 into fuel and chemical products worth about $9.10.

"Engineers' Dreams" is the title of a new book by science-popularizer Willie Ley. In it he describes fascinatingly grandiose schemes that reveal engineers as the most imaginative of humans.

Typical items: (1) A tunnel under the English Channel was first proposed in 1802, actually started in 1880 and stopped in 1884 when the British War Office thought twice about such an easy link to the Continent. (2) A dam near the mouth of the Congo would form a lake the size of California, Nevada and Oregon and fill the Chad Sea in the Sahara, improving the climate and enabling ships to reach the heart of Africa. (3) Damming the Red Sea, and even the Mediterranean, would allow evaporation to drop levels, expose new land, generate power by inflow and, in the case of the Mediterranean, make western Europe balmier by bringing the Gulf Stream nearer.

These samples give an idea of a book that's more stimulating than opium smoking, and cheaper – price is $3.50, publisher is Viking Press, Inc.

California's first hydro plant, on Angels Creek, went into action in 1899; its power aided gold miners of the old Utica Mining Co. Bought by Pacific Gas & Electric in 1946, its replacement was delayed, and PG&E prayerfully kept the old generators going. One went out of business a few years ago, but the other kept on until a new $1.3 million plant half a mile downstream was ready.

Old plant, rated 1900 kw, needed four operators. New one, twice as big, is fully automatic, controlled from Stanislaus powerhouse miles away.

When a whale smells bad you've got trouble and that's just what began to happen to Jonah. Heavily dosed with formaldehyde, Jonah has been touring Europe on a large truck since late in 1952. Not long ago, according to Refrigerating Engineering, Jonah began to develop a certain fragrance.

To preserve this profitable exhibit, the owners put a refrigerating system on the truck and three evaporators in the whale's stomach. This keeps temperature at 32 F, offsets the heat of putrefaction, promises to prolong Jonah's career, and makes him history's first air conditioned whale.

Lou Rowley

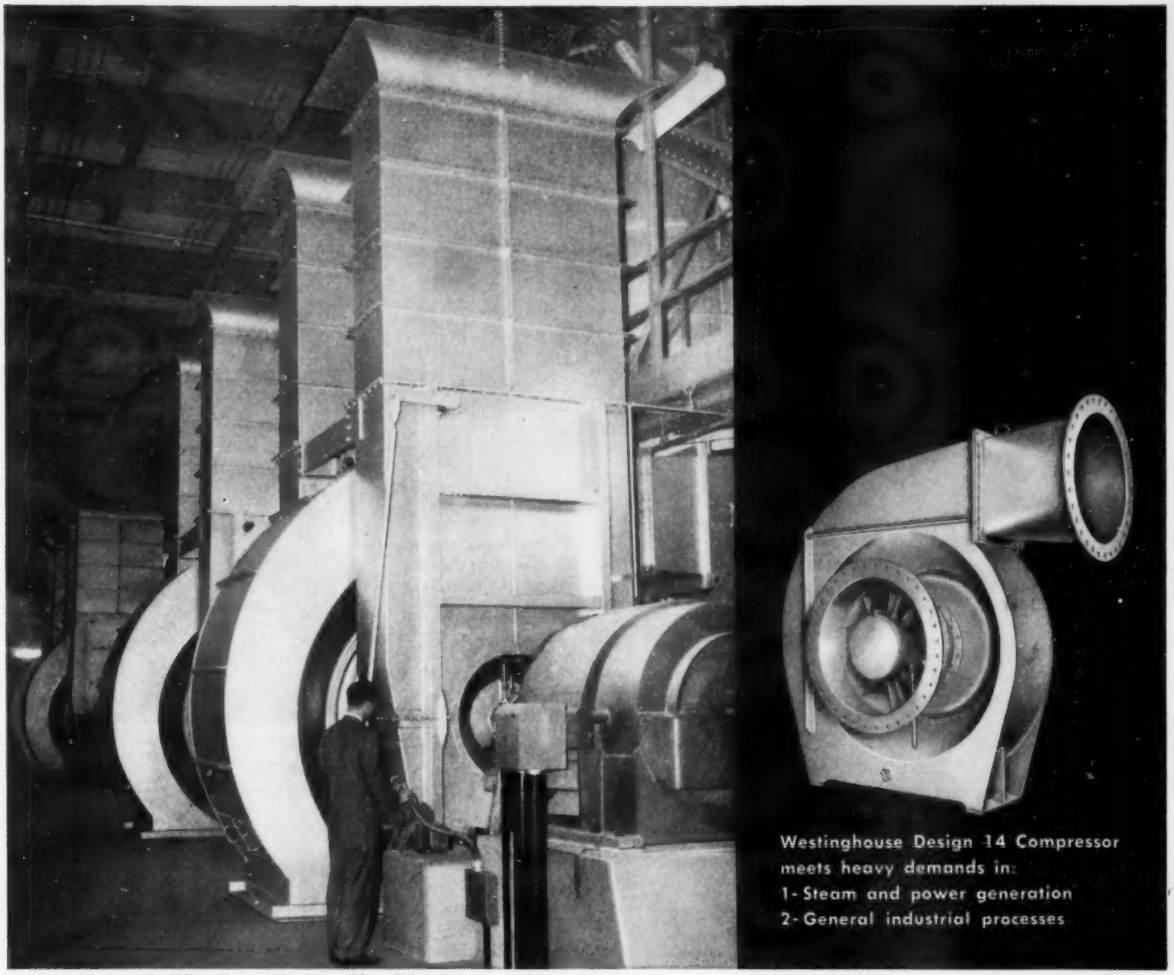

Westinghouse Design 14 Compressor
meets heavy demands in:
1- Steam and power generation
2- General industrial processes

Photo courtesy Ohio Edison Co. at Niles Power Plant, Niles, O.

4 Westinghouse High-Pressure Compressors Supply Air to Cyclone Furnaces in New Ohio Edison Plant

Four Westinghouse Design 14 high-pressure Compressors supply forced draft to the two Cyclone furnace boilers at the new Niles Power Plant of Ohio Edison Company. Capacity of each boiler: 885,000 pounds of steam per hour. Working two to a boiler, each Design 14 Compressor delivers 135,000 cfm at 70 inches of water while operating at 1775 rpm. Westinghouse vane control regulates air volumes as required.

Design 14 Compressors are rugged, efficient, responsive to changing demand . . . maintain output while cutting costs. They provide variable or constant air volumes at constant pressures for many important industrial processes. Such as: atomic pile cooling, catalyst and scavenging blowing, supercharging diesel or gas engines, ore flotation. For these and other uses, Design 14 Compressors are available in single-width or double-width arrangements, with capacities up to 200,000 cfm and pressures up to 110 inches water gauge.

QUIET OPERATION—Casing proportions and streamlined wheel passages make Westinghouse Design 14 Compressors *inherently quiet*. Accessory sound-absorbing trunks of proved design reduce noise level even further.

A Sturtevant specialist located in your area will assist you now in selecting Westinghouse Design 14 Compressors for your specific requirements. Call him. Or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

WESTINGHOUSE AIR HANDLING

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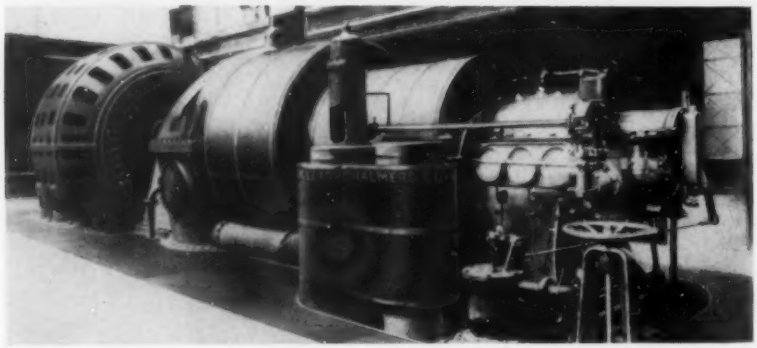
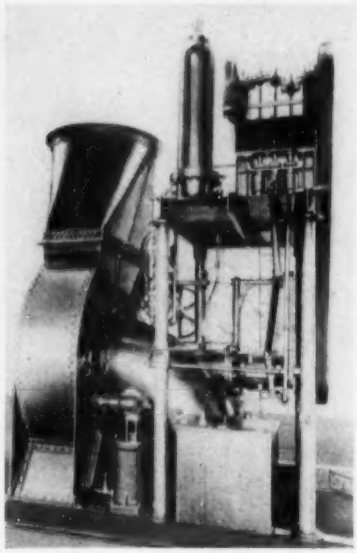
READER SERVICE SECTION

POWER NEWS ____ 160
TECHNICAL BRIEFS ____ 162
PLANT EQUIPMENT NEWS ____ 166
NEW FREE BULLETINS ____ 175





OBSERVANCE IN 1954 of Allis-Chalmers Manufacturing Co's golden anniversary in the steam and hydraulic turbine field recalls this 5500 kw, 750 rpm, 25 cycle steam turbine unit, *above*. It was the first built by the company and was installed in 1905 for the Brooklyn Transit Development Company

FIRST HYDRAULIC TURBINE manufactured by Allis-Chalmers 50 years ago, is this single horizontal plate steel cylindrical casing Francis runner type unit, *right*. It was rated 1250 hp under 88 ft head at 360 rpm and is still in operating condition. In contrast are the 115,000 hp, 480 ft head turbines presently in use at Hoover Dam

Atomic power for Canadian industry

► CANADIAN ATOMIC ENERGY authorities have established definite conclusion in recasting the role atomic power is to play in Canadian economy. A program of research and development has been launched, aimed at the commercial use of reactor-made power within ten years. The program is a result of an appraisal of the water power resources available in Canada's highly industrialized Southern Ontario region.

The objective of the program is to have a power reactor in operation by 1962. It is hoped this reactor will feed power into the Southern Ontario power grid at a cost of five to six mills per kw hr, or at the present day cost of producing power from steam-drive generators using coal at $8 per ton.

The first step in the program is underway. Experts and scientists of Hydro-Electric Power Commission of Ontario and Atomic Energy of Canada Ltd, are working on a feasibility study to prepare designs and cost estimates for a pilot atomic power plant. This plant, to be operating in three years, will run for about two years before a full-scale commercial reactor is built.

Power requirements of the Southern Ontario region have increased from 498,000 kw in 1922 to 2,766,000 kw in 1952. Present water resources are sufficient to sustain an increase at the same rate until 1958. Intervention of the St. Lawrence River power project will see the region through until 1962. At that time, when Ontario runs out of water power, it is expected that the objective of atomic power at competitive cost will be a reality. Other industrial areas in Canada are in a less critical state due to greater water power potential in relation to growth requirements and availability of local coal supplies.

Pending completion of the feasibility study, Canadian Atomic authorities decline to discuss the program in terms of money required or the type of reactor favored. At present, however, the government is spending $40,000,000 on the second research reactor, NRU, under construction at Chalk River. It is presumed that a comparable sum will be spent for development of the proposed power reactor. Physical development is likely to be based on Canada's existing experimental reactor, NRX, and the larger NRU nearing completion. These are slow reactors using natural uranium rods as fuel and heavy water as the moderator. Modifications will be made to adapt the pattern of these units to power generation.

For coming events see page 252

Fire test service offered by Ansul

► ANSUL CHEMICAL CO, manufacturer of dry chemical fire equipment, is offering an unusual testing service to plants or industries with special fire hazard problems, especially those involving volatile chemicals, plastics, gases, metals or other substances. Any company with such hazards may submit its problem to Ansul engineers who will attempt to work out the solution on its 7-acre fire test field, considered one of the best equipped fire extinguishing laboratories in the world.

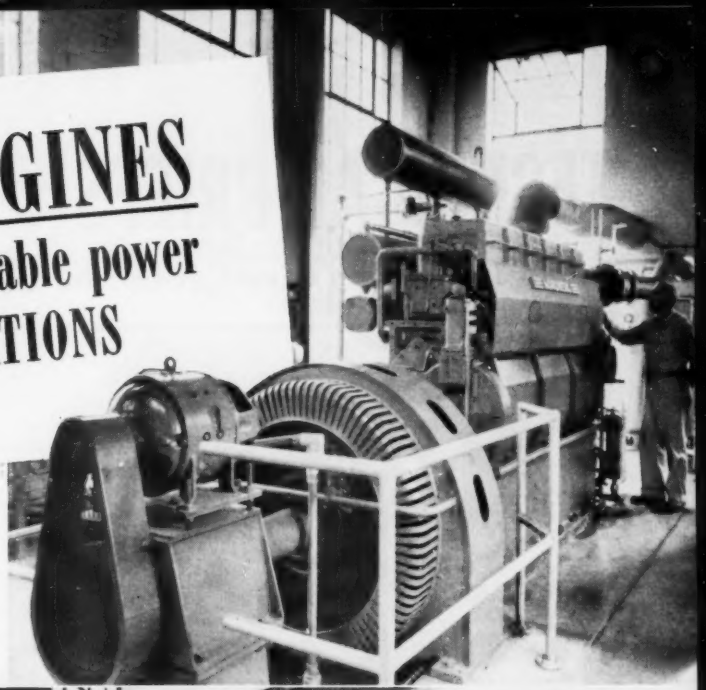
Two problems recently submitted, involved methods of extinguishing fires in vinyl chloride, a highly volatile chemical used extensively in the plastics industry, and lithium aluminum hydride. In both cases extensive tests, under a wide variety of conditions, proved dry chemical the preferred method of extinguishment. However, Arthur B Guise, chief engineer, made it clear his engineering staff has not hesitated to recommend other extinguishing agents if they were found more suitable.

For example, a large chemical company asked Ansul to conduct tests on methyldichlorosilane fires. Exhaustive research showed, because of low auto-

(*Continued on page* 250)

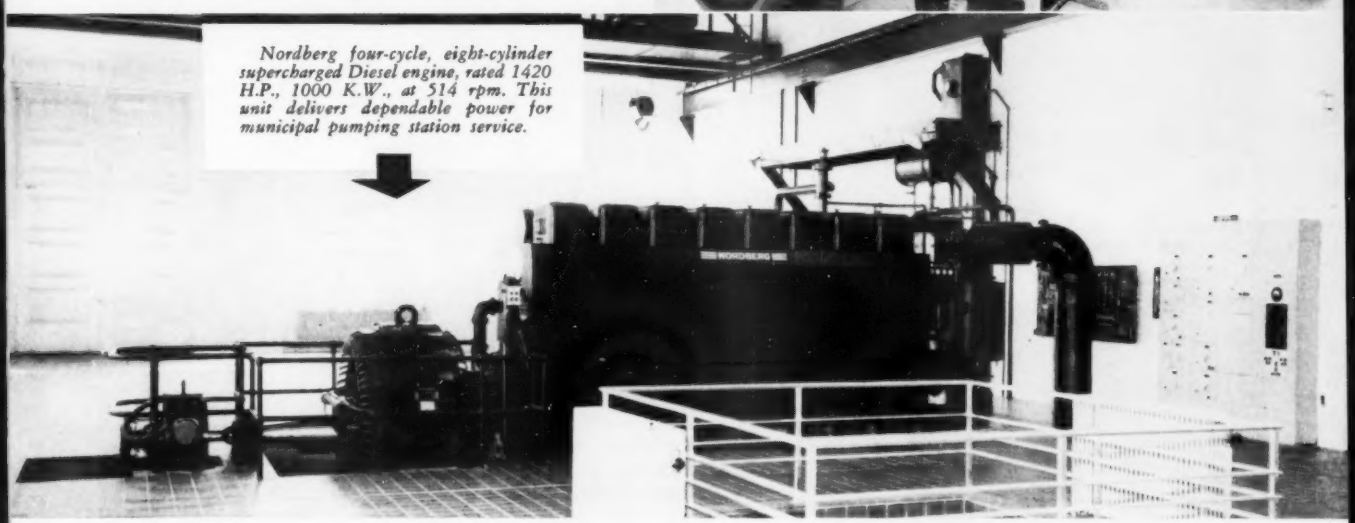
NORDBERG ENGINES

furnish low cost, dependable power for PUMPING STATIONS



Nordberg four-cycle, six-cylinder Duafuel® engine rated 375 H.P., 250 K.W., at 600 rpm. This unit, operating on natural gas, powers two motor-driven centrifugal water pumps.

Nordberg four-cycle, eight-cylinder supercharged Diesel engine, rated 1420 H.P., 1000 K.W., at 514 rpm. This unit delivers dependable power for municipal pumping station service.



WHEN it comes to furnishing reliable, low cost power for municipal and industrial pumping operations, Nordberg engines have been thoroughly job-tested and proved in numerous installations in many parts of the world. Two typical Nordberg Diesel Engine Generator units are shown here, each providing the necessary power to keep electrically-driven water pumps on the job, day-in, day-out.

Built to provide the most economical power plant with low first cost as well as low operating costs, Nordberg engines will efficiently burn Diesel fuel, natural gas, or any combination of both—as well as sewage gas, manufactured gas and propane. With this wide fuel selection Nordberg can furnish the most efficient unit to meet specific power requirements . . . for pumping applications and for main or stand-by-power in almost every class of service.

Nordberg, as builders of America's largest line of heavy duty engines, in sizes from 10 to over 10,000 H.P., backed by over a half century of specialized machinery building experience, can give you valuable assistance in solving *your* particular power problem. Call or write for further information. *Nordberg Mfg. Co., Milwaukee, Wis.*

NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

P554

TECHNICAL BRIEFS

Latest engineering developments for busy power men

10 Digests for you on:
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WATER TREATMENT
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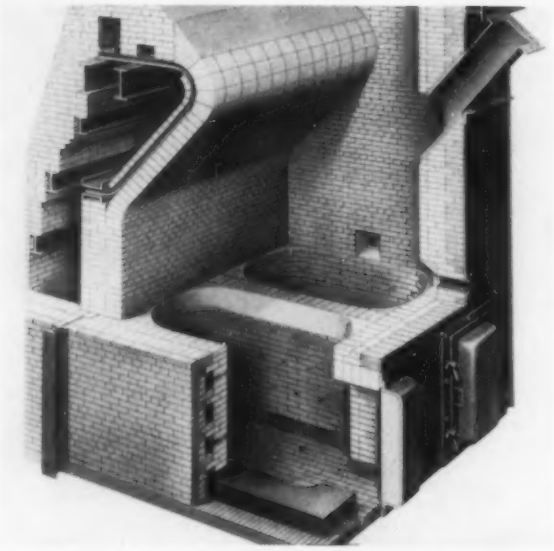
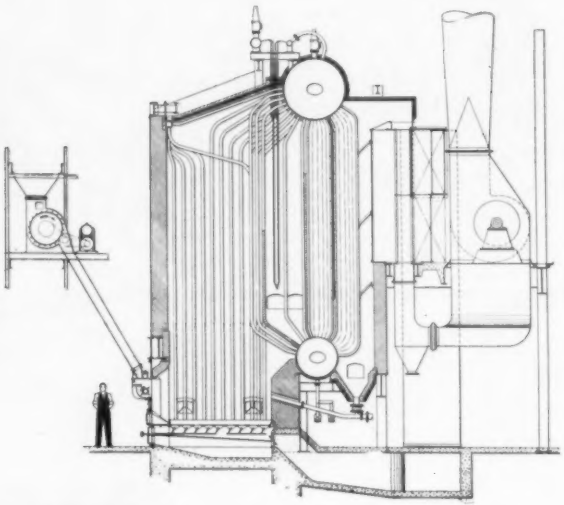
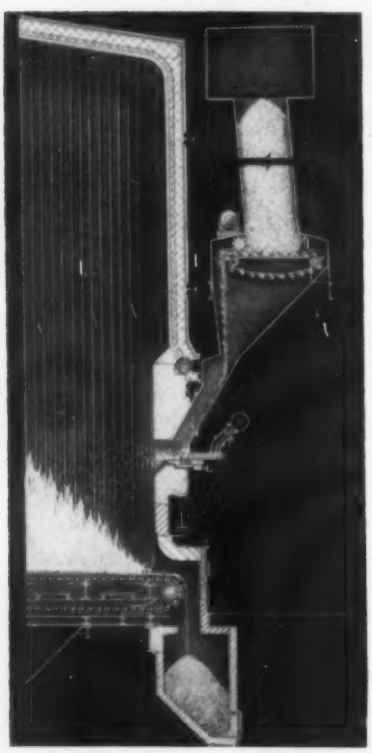
DIESELS



1 The Ward furnace is a widely used hearth-type furnace



2 Bagasse firing in mechanical spreader-stoker boiler



3 Pneumatic spreader stoker has chain-type bagasse feeder, and traveling grate

Modern practice in burning bagasse

Bagasse Burning in the Mexican Sugar Industry. *By Otto de Lorenzi, Fuels Consultant, Combustion Engineering*

Bagasse is the principal source of heat for the production of raw sugar. Early furnace designs were satisfactory from the standpoint of operation and steam output during the period when labor was plentiful and this byproduct fuel was assigned little or no value. But rising costs of fuel, equipment, wages and repairs have altered this picture.

Older plants had a large number of small boilers with refractory hearth-type furnaces. Operating efficiency was low, with steam output dropping during long periodic hearth cleaning. Rapid advances in the last ten years have definitely outmoded these designs.

Newer steam-generating units use spreader stokers. Fig. 2, watercooled furnaces, bent-tube boilers, superheaters, air heaters and bagacillo return systems. They have more flexibility, greater capacity, higher efficiency and are less subject to operating interruptions. Many of these units have operated for long periods in practically all the world's raw sugar producing areas.

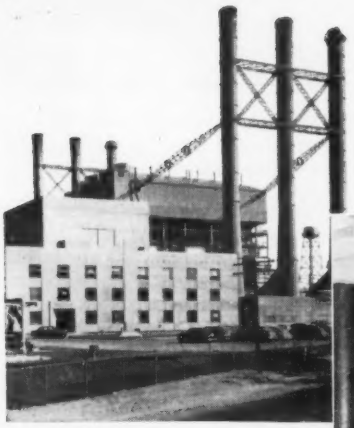
The variable-speed drum-type feeder is perhaps the most important contribution to the success of bagasse stoker firing. Distribution of the fuel over the grate surface in a level and thin layer is of considerable importance in assuring uniform flow of undergrate air through all fuel-bed sections.

Drum-type metering feeders, mechanical spreader units and thin active fuel beds provide an ideal combination for application of automatic control systems. Since few sugar mills in Mexico are instrumented, the first step towards modernization should be instrumentation. *ASME paper No. 54-MEX-4.*

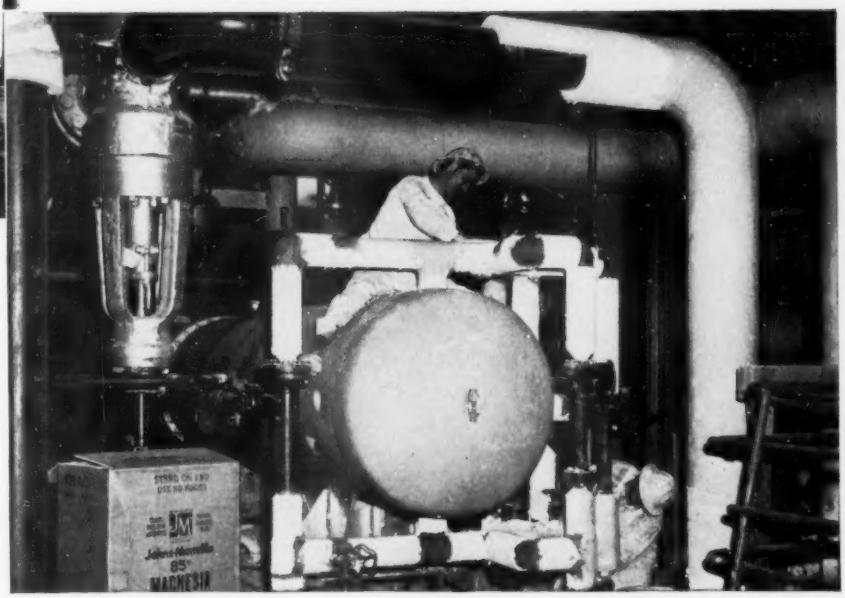
The Spreader Stoker in the Sugar Factory. *By Earle C Miller, Research Engr, Riley Stoker Corp.*

The spreader-stoker-fired boiler provides the sugar producer with equipment possessing advantages uniquely suited to steam-load demands and the normal fuel supply of his factory. Combustion principles, component parts of the spreader stoker, and engineering considerations in the application of spreader-stoker-fired boilers to sugar factories are explained in this paper.

(*Continued on page* 164)



At the new Moss Landing generating plant



(Top) Moss Landing, California steam plant of the Pacific Gas and Electric Company, designed by Stone and Webster Engineering Corporation, under the supervision of the P. G. and E. Engineering Dept.

(Right) Skilled applicators of an outstanding J-M Insulation Contractor, Western Asbestos Company of San Francisco, applying J-M 85% Magnesia to pipelines during construction of the Moss Landing plant.

P. G. and E. INSULATES WITH SUPEREX-85% MAGNESIA TO LOWER POWER PRODUCTION COSTS

When Pacific Gas and Electric Company invested $80,000,000 in its new 771,000-horsepower electric generating giant at Moss Landing, California...the insulation, like all other materials, had to meet rigid specifications. *For this important project, Johns-Manville Superex-85% Magnesia double-layer insulation was used on superheated steam pipes.*

Superex Combination Insulation consists of Superex*, a J-M insulation for temperatures to 1900F, and J-M 85% Magnesia. It was installed at the Moss Landing plant for maximum thermal efficiency and long trouble-free service. This double-layer construction, proved in over a quarter-century of outstanding on-the-job performance, utilizes the higher heat resistance of Superex next to the hot surface—the greater insulation value of J-M 85% Magnesia for the outer layer. It eliminates through joints, protects the jacket against scorching and is unharmed by expansion encountered in pipes carrying superheated steam.

J-M 85% Magnesia is the leading insulation for temperatures to 600F. It will not distort regardless of its length of service. It fits snug, stays tight. Heat savings, therefore, remain constant for the life of the equipment on which it is applied.

Whatever the insulation—it must be properly engineered and installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced J-M Insulation Engineers and J-M Insulation Contractors. These men stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings.

For further information, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

Double-Layer Superex-85% Magnesia Insulation was used on superheated piping at the P. G. and E. Moss Landing plant.

*Reg. U. S. Pat. Off.

Johns-Manville *FIRST IN* INSULATION

MATERIALS • ENGINEERING • APPLICATION

More TECHNICAL BRIEFS

Begins on page 162

Spreader-stoker firing of bagasse is the most recent development in boiler practice in the sugar industry. Its use reduces capital investment, maintenance and labor costs, and gives high availability. Combustion conditions are excellent and the absence of clinkers in the bagasse ash is immediately noticeable.

Development of a trouble-free bagasse feeder with storage ultimately reached the design shown in Fig. 3, p 162. Full automatic combustion control is possible with this unit, feed rates being selected for about 20% above maximum boiler capacity.

Control ranges for the variable-speed drives range from 3 to 1 in some installations to 6 to 1 in others. The 3 to 1 range controls from 40 to 120% of rated capacity and the 6 to 1 range from 20 to 120%.

Bagasse distributors must be selected to assure fuel distribution over the grate. Pneumatic distributors use an air jet to explode the flowing bagasse as it passes into the furnace. The air blast breaks up any wet mass of bagasse.

Stationary, dumping or traveling grates may be used in bagasse firing. Jets to create furnace turbulence are necessary for optimum performance of spreader stokers. Either steam or air jets may be used, but air jets are generally accepted as most desirable.

Other factors important in applying spreader stokers for this service include reinjection of flyash to improve combustion efficiency and reduce cleaning labor, a furnace heat release of 25,000 Btu per cu ft per hr for good efficiency and reduced flyash, and multiple-fuel firing.

Wood, oil, gas or coal can be used for continuous makeup or during interruptions in bagasse supply. Proper selection of the stoker, furnace and auxiliary equipment provides a steam-generating unit adaptable to any fuel supply for many years.

Other considerations in plant design include controls, forced- and induced-draft fans, and variations in fuel supply. *ASME paper No. 54-MEX-5.*

Bagasse as a Fuel for Steam Generation. *By F D Wilson, Export Dept, The Babcock & Wilcox Co.*

Bagasse has been used as a fuel ever since sugar in crystalline form has been produced from sugar cane. This goes back about 200 years. Physical characteristics vary widely, depending on how the cane is handled in the mill. With crude handling, the bagasse is a flat semi-stiff ribbon 5 to 6 ft long and about 2 in. wide. In modern mills the bagasse has 15 to 20% fines, the remainder being a mass of snarled and twisted fibers. With a series of crusher rolls and extraction mills, bagasse texture is about the same as in a crude mill but the pieces are only 1 to 14 in. long.

Most bagasse today varies in consistency between the last two types. It is difficult to handle in bins or chutes. However, special handling techniques including slat conveyors, smooth almost-vertical open chutes, and other devices, permit ready use. To reduce the danger of spontaneous combustion during long periods of storage, the material is compressed and baled.

With modern milling practices, moisture content of bagasse averages about 50%. The fuel burns easily without predrying.

At present it appears that for many years in the future, bagasse will have few other uses except as a fuel. And the fuel-burning equipment must be extremely simple and easy to operate because there is a high rate of labor turnover in sugar mills grinding only four or six months of the year. To make bagasse attractive from the cost standpoint, fuel-burning equipment should be relatively cheap. In properly designed and operated sugar mills, there is enough bagasse to provide all the heat needed.

Two general types of furnaces are used to burn bagasse today: the hearth and grates types. The Ward furnace, see Fig. 1, p 162, is the hearth-type furnace that is the most widely used today. In it fuel is burned on a refractory hearth surrounded by brick walls forming a hollow cell roughly the shape of a horseshoe. Overhead inclined arch forms a restricted entrance to the combustion zone in the furnace above. Fuel is introduced to the furnace through a chute and passes through the products of combustion where smaller particles burn in suspension. Larger pieces are partially dried, drying being completed on the pile.

Today the spreader stoker is considered the best grate-type furnace for a modern mill. At present a hearth furnace costs about 75% as much as a spreader-stoker grate-type furnace, Fig. 2. *ASME paper No. 54-MEX-6.*

Piping

Selection, Maintenance and Piping Practice in Industrial Plants. *By Robert J Pinske, Power Plant Engineer, Crane Co.*

Efficient piping systems are an important influence on plant operating economy. Many plants recognize this and make every effort to properly plan, correctly install and adequately maintain their piping systems. Other plants, using poor layouts, suffer from the standpoint of efficiency. Haphazard piping extensions which eventually cause overloads are common. Or maintenance is neglected or performed only when a part fails. Costs are higher, output is reduced or irregular.

Piping always represents a sizable part of the cost of any plant. It may be 20% or more of the entire cost of the plant, and may total from 10 to 67% of the equipment cost. Piping maintenance in most plants runs from 0.5 to 2% of the sales dollar.

Many piping systems are complex, consisting of numerous small and isolated parts. Components are thought of as being stationary and subject to little wear. This misunderstanding is probably the main reason why piping maintenance is neglected to a shameful degree in many plants today. Actually, these plants pay for their piping over and over again in unnecessary expenditures.

This paper is based on a survey of 117 plants of various types in which plant

(*Continued on page* 206)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Power Conference, annual meeting, Sherman Hotel, Chicago, Ill., Mar 24-26, 1954. Identified by initials APC. Obtainable in proceedings that may be purchased from R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

American Society of Mechanical Engineers, International meeting, Mexico City, D F, Mexico, Mar 10-12, 1954. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Society of Lubrication Engineers, convention, Cincinnati, Ohio, Apr 6, 1954. Identified by initials ASLE. Information as to availability of texts from W P Youngclaus Jr, ASLE, 84 E Randolph St, Chicago 1, Ill.

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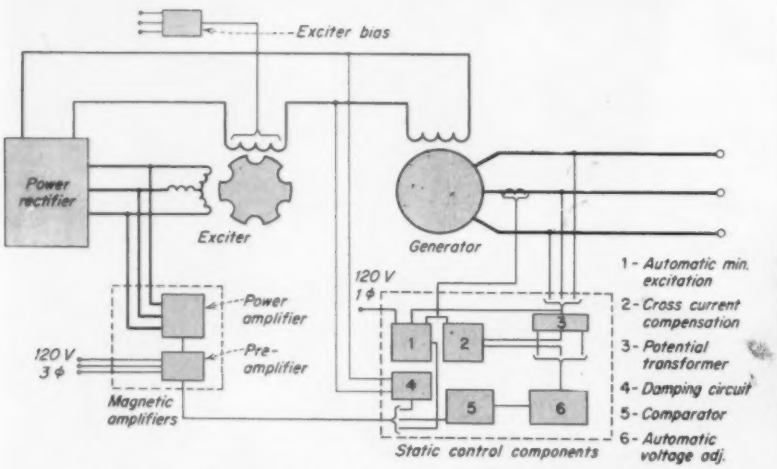
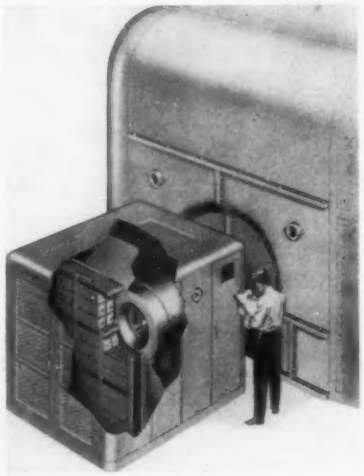




Excitation System Uses 360-Cycle Inductor-Type Alternator to Generate Excitation Power

601 • Shortcomings of dc exciters are claimed to have been eliminated in this exciter system through the use of a 360-cycle inductor-type alternator to generate the excitation power. The new development is available as original equipment with turbine generator units or for modernization of older generators.

In this system, brushes and commutator of the conventional exciter and all rotating windings have been eliminated by substitution of an inductor alternator for the usual dc machine. Power for excitation is generated at high frequency and then changed to direct current by a bank of selenium rectifiers. The rotating element of the new exciter is adaptable to over-hung mounting on most 3600 rpm generators in which case couplings, gears and extra bearings are eliminated. Other than the inductor generator, only static components are used.

When compared with the conventional dc exciter regulator system, the new exciter is expected to virtually eliminate maintenance while providing top reliability and long-time trouble-free performance.

Inductor alternator type exciter in the new system is under the control of magnetic amplifiers through a circuit sensitive to the main generator terminal voltage. Standard plate-type selenium rectifiers convert the high frequency output of the inductor alternator to direct current for exciting the main generator field and the exciter series field. Rectifier stacks are connected in a three-phase bridge connection with the parallel circuit of each arm of the bridge arranged to permit convenient check of rectifier condition during operation. Stack connections are so arranged and fused that loss of one stack of plates will not shut down unit.

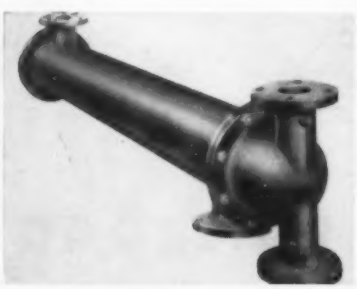
Inductor generator has inherently high reactance and is especially sensitive to lagging-power-factor loads. Control signal to magnetic amplifier is obtained from potential transformers on main generator terminals through a comparator circuit and a magnetic pre-amplifier. Output of main generator is controlled with a high degree of amplification by using the magnetic amplifier as a variable reactance load.

Because the exciter has in effect no time constant of its own, the speed of response as a delaying factor in restoration of voltage is governed mainly by the short time constant of magnetic amplifiers.

Perhaps the most interesting advantages are that two of today's major causes of excitation headaches, commutator maintenance and brush replacement are eliminated.

The first of these new exciter systems will be installed on a 43,750 kva, 3600 rpm air-cooled turbine generator at the Iowa Power and Light Co. Generator had been installed in 1938 without a direct-connected exciter, excitation power being supplied by a motor-generator set. The new system, nominally rated 110 kw, 250 volts dc is a portion of a current program to modernize the station. Complete information and specifications available from manufacturer.

Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.



Tubular Heat Exchanger

635 • Tubular heat exchanger cools liquids or gases. Built to comply with ASME code, it is available in various combinations of ferrous and non-ferrous materials. Unit is assembled from standard parts. Full information from manufacturer.

Doyle & Roth Manufacturing Co, Inc, 136-50 24th St, Brooklyn 32, N. Y.

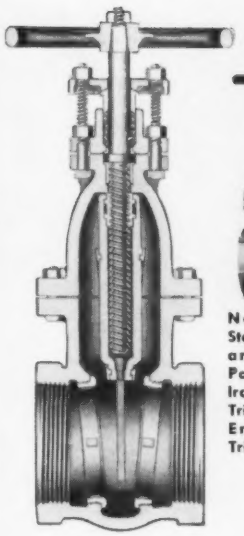
For more data on these items, use post cards p 175. Identify your request with item number.

Watthour Meter

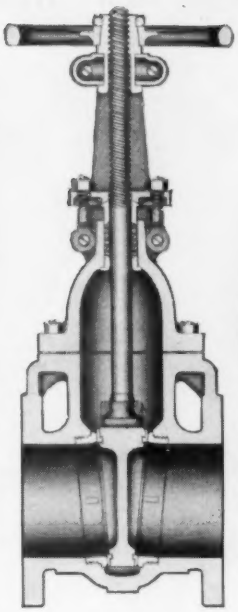
642 • New 50-a, single-phase watthour meter has straight-line accuracy up to 200 a and load range more than three times that of standard 15-a I-50 meter with no increase in external dimensions. Redesigned stator provides higher accuracy. Current coils, assembled from die-made parts, are completely brazed. Coils are molded in butyl rubber to achieve coordinated insulation level.

General Electric Co, Schenectady 5, New York

Crane 125-Pound Iron Body Wedge Gate Valves are an improved design, embodying many features of unusual merit. They set a new peak for quality in iron body wedge gate valves, having greater strength, longer life, and better all-round adaptability for all types of services.



Non-Rising Stem; Screwed and Flanged Patterns; All-Iron or Brass Trimmed. Hub Ends, Brass Trimmed only.



Outside Screw and Yoke; Screwed and Flanged Patterns; All-Iron or Brass Trimmed. Also available with brass seats and steel stem.

See If You Don't Agree!

Here's the big value—the big selection: CRANE 125-Pound Iron Body Wedge Gates

. . . with quality features that assure exactly the kind of service you want. Body and bonnet are oval-shaped with extra metal where it's needed most, to provide liberal strength. Flanged patterns have tie-ribs between body and bonnet flanges. You also get a solid web-type disc with long guides . . . a stem of liberal diameter with long thread engagement . . . an exceptionally deep stuffing box with high-grade packing . . . a two-piece ball-type gland and flange—plus an easy-to-grip handwheel with oval-shaped rim. Non-rising stem valves have a brass bushed stem collar. OS&Y design includes a brass bonnet bushing, swinging eye bolts . . . and a tee-head disc-stem connection on sizes 12-inch and smaller.

Big selection includes all-iron or brass trimmed valves . . . Underwriters' pattern valves, quick-opening types . . . valves for process industries . . . valves for marine service. Sizes up to 48-inch. Check your Crane Catalog or ask your Crane Representative next time he calls.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 166

Improved 2-Cycle Diesel Engines Feature 36% More Power Output

602 • Improved line of 2-cycle diesel engines is said to carry 52 major advancements and refinements and to produce 36% greater power output. Operating speed of the new models has been increased to 1800 rpm delivering 58 to 255 hp. Compression ratio of all models is 16 to 1 and bore and stroke are 4.5-in. x 5.5-in. Displacement is 87 cu in. per cylinder.

Most important change, according to the manufacturer, is the completely redesigned cylinder assembly. More effective and complete scavenging is achieved by a new valving arrangement and redesigned porting. Increased power ratings result from the greater volume of cool air supplied all cylinders by new blower construction.

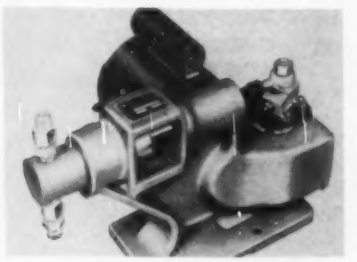
Other major refinements include new design of the combustion chamber, new flat-top pistons and new exhaust manifolding. Complete information and specifications available on request.

P&H Diesel Engine Div, Harnischfeger Corp, Crystal Lake, Ill.

Diesel Exhaust Muffler

618 • Twin-flow heavy-gage steel catalytic muffler reduces noxious components of 4-cycle diesel engine exhausts. Flanged end of the device attaches directly to engine exhaust manifold and burns, by catalytic action, carbon monoxide and hydrocarbon fumes in exhaust gases. Full details as to applications on request.

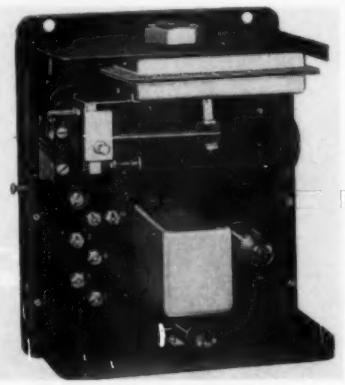
Oxy-Catalyst Inc, Wayne, Pa.



Proportioning Pump

612 • Proportioning pump, *model 1105-S*, is now available as either a 10-gal or 20-gal per hour pump with open or explosion-proof motors and in a variety of voltages. Among features of these pumps are a self-aligning connecting rod and a one-piece barstock cylinder. Measuring cylinder assemblies are of either standard steel and stainless trim or of 316 stainless steel with ceramic plungers. Bulletin 1105-S.

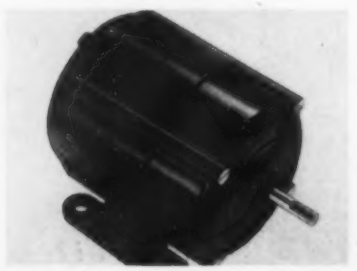
Proportioneers Inc, Providence 1, R. I.



Low-Draft Cut-Off

629 • Switch protects boilers from mechanical or natural draft failure, prevents shutdowns caused by momentary puffs. It replaces conventional make-or-break switches and is suitable for all firing methods and boiler types. Control is available in two units: *Model LDT-A*, for interruption of low voltage burner control circuit; and *Model LDR-A*, for line voltage interruption. A plug-in relay can adapt the *LDT-A* for line voltage use. Terminals are available for wiring to 115 or 230 volts ac.

Cleveland Fuel Equipment Co, Cleveland 9, Ohio



Electric Motors

643 • New series motor, model 512, is also available as shunt motor. Unit is die cast from zamak #3 and held to close tolerances. Housing is ribbed for greater strength. Either porous bronze self-aligning sleeve bearings with oversize felt oil reservoir or precision grease-sealed ball bearings are available. Model 512 features either open or closed construction. Full specs and optional features are available on request.

Howard Industries, Inc, Racine, Wis.

For more data on these items, use post cards p 175. Identify your request with item number.

COMPARE

And See WHY Industry Specifies

ANKORITE INDUSTRIAL HOSE

Ankorite industrial hose is especially designed to meet existing conditions and perform specific functions. Review its superior construction features and you will see why industry specifies Ankorite hose:

CONSTRUCTION

There are three basic parts . . . Tube, Carcass and Cover.

THE TUBE

is proofed against harm from air, liquid, oil, gas, acid, heat or other materials. Smooth, it permits free-flow, and is non-porous to free the carcass from seepage of harmful substances.

THE CARCASS

is strong and rugged, easily withstands pressures and temperatures with a wide margin of safety. Will not break down even under the strain of continuous flexing. Made of cotton duck plies or braids impregnated with rubber compounds to bond firmly.

THE COVER

is made to withstand external abuse from abrasion, rough treatment, or harmful materials.

FREE COPY

of a new color folder describing ANKORITE HOSE will be sent you upon request. Write for your copy today.

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FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

More EQUIPMENT NEWS

Begins on page 166

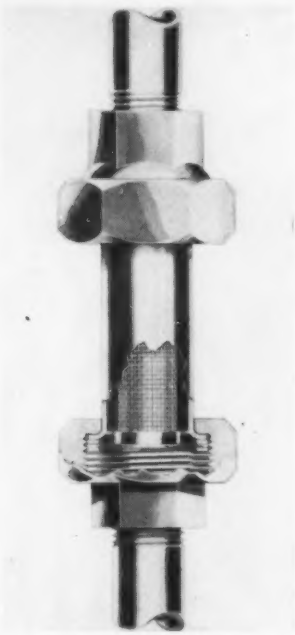
Wire Braid Hose Withstands Weight of Freight Car

603 • A recent test showed this wire braid heavy-duty air hose capable of withstanding the weight of a railroad freight car. For the test a length of *Commander* air hose was filled with 400 psi air and placed beneath the wheel of a freight car. The hose retained full pressure and the freight car wheel failed to cut, abrade or permanently distort it.

After this test, the same length of hose withstood a laboratory burst test up to 4300 psi, a ten to one safety factor since the hose is recommended for 400 psi working pressure. When the hose finally failed in the laboratory under extreme pressure, the failure did not occur in the part that had previously been under the weight of the freight car wheel.

The air hose is recommended for service in mines, quarries, construction projects and general industrial use where high working pressures are required. Extremely flexible, the hose is reinforced with a single braid of high tensile steel wire. An oil-resistant tube permits tools to be oiled through the hose.

The B F Goodrich Co, Akron, Ohio

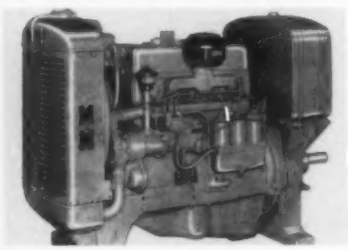


Straight Line Strainer

608 • Straight line strainer protects appliances, equipment, valves and controls, provides clean uninterrupted flow of water, air or gas. New construction is said to eliminate unnecessary friction, loss and turbulence. Union couplings enable quick installation and cleaning. All parts are non-corrosive. Available in ¼-in. to 1-in. pipe sizes. Full details available on request to the manufacturer.

Industrial Sales Div, Hays Manufacturing Co, 814 W 12th St, Erie, Pa.

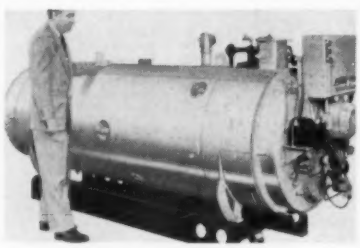
For more data on these items, use post cards p 175. Identify your request with item number.



Diesel Engine

644 • New, popular-sized diesel power units incorporate latest in development. New energy cell design reduces fuel consumption and provides cleaner exhaust as well as longer engine life. Other advantages include simplified single-plunger fuel injection system, improved package water pump and two water-coolant nozzles for each fuel injector nozzle. Full details available.

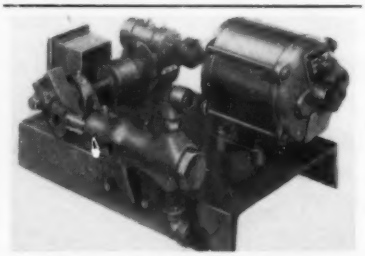
Minneapolis-Moline Co, Minneapolis 1, Minnesota



Packaged Boiler

610 • Compact, self-contained boiler may be adapted to commercial, industrial and institutional structures. Marked advantages of unit, according to the manufacturer, are: silent operation, with remarkably low decibel rating, maximum accessibility for operation and maintenance and electronic combustion safety control. Unit is available in sizes from 15 to 40 hp.

Cleaver-Brooks Co, 326 E Keefe Ave, Milwaukee, Wis.



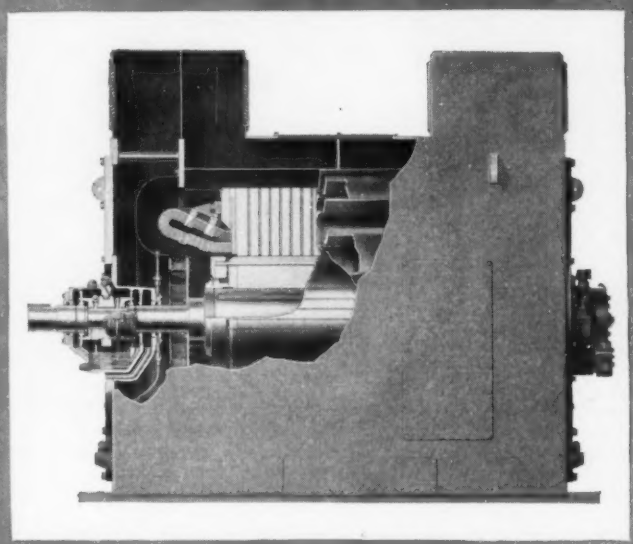
Controlled Volume Pump

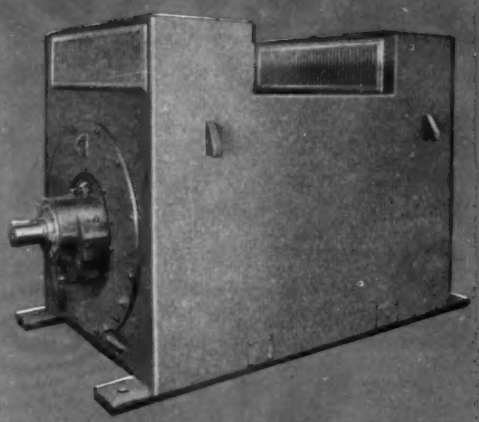
621 • Motor driven controlled volume pumps for use in proportional feed systems have capacities from one pint to 1350 gal per hour, against discharge pressures up to 50,000 psi. Mechanical single revolution clutch arrangement permits one stroke of pump in response to electrical signal to effect feed of additive in proportion to main line flow rate. Full details on request.

Milton Roy Co, Station Q, 1300 E Mermaid Lane, Philadelphia 18, Pa.

Redesigned

INSIDE AND OUT





ALLIS-CHALMERS
Boiler-Feed Pump
MOTORS

New features improve 2-pole motors long known for reliability and low maintenance.

New ventilating arrangement features top air intake and discharge *plus* spiral stator core ventilation. Top intakes (available with filters) keep motor clean and make motor room cleaning easy; top discharge adds to personnel comfort. Spiral ventilation — used in turbine generators — assures even internal cooling . . . combines with centrifugal fans and baffled air passages to reduce noise.

Improved bearing design simplifies maintenance, prevents oil leakage. Capsule-type housings — proved in use on other designs — permit inspection of windings without exposing bearings. Oil leakage is prevented by a combination of features, including orifice-metered oil flow, weirs to maintain correct oil level, labyrinth seals, breathers, and annular pressure chambers with atmospheric relief.

Clean-cut appearance is gained by providing internal space for stator and auxiliary leads, etc.

Features that helped build the Allis-Chalmers 2-pole motor reputation for reliability are retained in the new design. These include proven stator coil design, ample stator coil end bracing, thermally and mechanically stable cage assembly, separate balancing rings, and oxygen-free dew-drop cage bars.

This design available in ratings 900 hp and larger. Ask your A-C representative for Bulletin 05R8123. Allis-Chalmers, Milwaukee 1, Wisconsin.

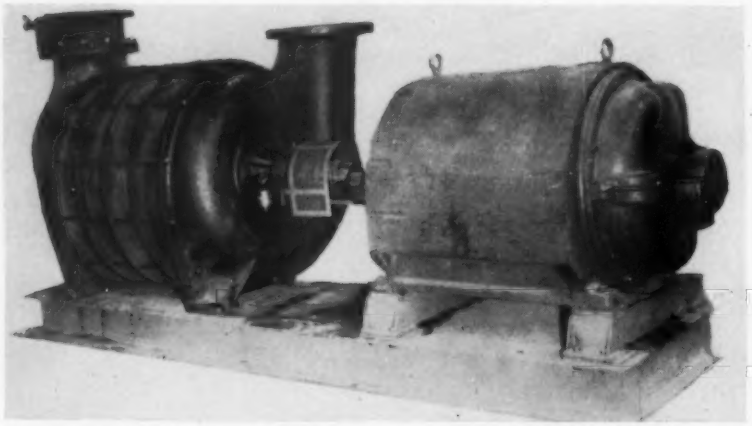
A-4350

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

More EQUIPMENT NEWS

Begins on page 166



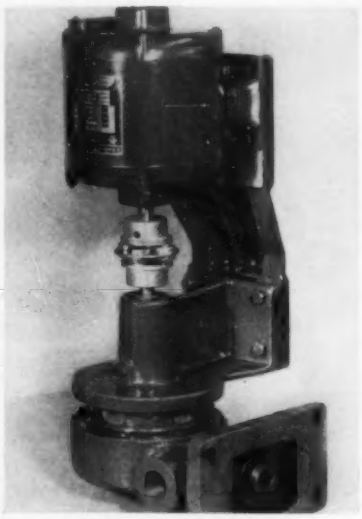
Centrifugal Blower Delivers Air Volume of 2000 to 9000 cfm

604 • Large volume, standard production centrifugal blower uses a combination of three interchangeable impellers to deliver any air volume between 2000 and 9000 cfm, with pressures ranging from 1 to 9 lbs gage, or vacuum from 2 to 12 in. Hg. Units can be equipped with impellers that import a non-overloading characteristic.

Blowers of the manufacturers' *Series 386* can be assembled from stock parts to meet the individual needs of customers, cutting delivery time and cost considerably. This series is of the same basic design as the manufacturers' conventional blower. The units are self-adapting to any variation in air volume requirements from minimum to maximum capacity.

Rotor and housing are designed to permit free air flow. Each impeller is statically balanced and rotating element is dynamically balanced to prevent vibration. Further data can be obtained from maker.

U. S. Hoffman Machinery Corp, Air Appliance Div, 105 4th Ave, New York, N. Y.



Centrifugal Pumps

614 • Redesigned models *FB-VBA* and *F-VBA* seal-type centrifugal pumps feature optional third outlet back through the intake port which is said to eliminate external piping. Both models are designed for flange mounting on the outer surface of a tank or reservoir. Positive prime is assured even with reduced height of liquid in the supply tank, insuring efficient operation with extremely low liquid level. Conventional right or left discharge outlets are available in addition to the new third outlet.

Pioneer Pump Div, Detroit Harvester Co, 14300 Tireman Ave, Detroit 28, Michigan

Engine Indicator Valve

613 • Newly designed engine indicator valve uses a free-floating nickel-alloy ball instead of the conventional tip of the valve spindle as the seating element. This makes possible opening and closing of valve by hand pressure with assurance of positive, tight closure under all operating conditions, according to manufacturer. Another practical advantage claimed for the valve is that it does not have to be removed from the engine for replacing any of its parts. Full information available on request.

Bacharach Industrial Instrument Co, 7301 Penn Ave, Pittsburgh 8, Pa.

Packaged Boilers

646 • *Powermaster* packaged automatic boiler line has been extended through 100 hp size. Models are also available for other fuels: *4L* for light oil firing, *4G* for gas firing and *4LG* for combination gas or oil firing. *Powermaster* is a 3-pass boiler with single flue gas flow reversal at either end. Minimum of 5 sq ft of heating surface is provided for each boiler hp. Full details available from manufacturer.

Orr & Sembower, Inc, Morgantown Rd, Reading, Pennsylvania

Gas-Engine-Driven Compressor

645 • New 2000-hp *Type 412 KVS* turbocharged compressor is extremely compact in size and economical in performance. Turbocharging consists of a combination of scavenging and supercharging by means of exhaust-turbine-driven centrifugal blower. All power for these operations comes from normally wasted pressure and velocity energy of exhaust gas. Unit has four compressor cylinders, all on one side of engine and spaced five ft apart. This simplifies piping and allows unrestricted access to engine from other side. Full construction and operation details available on request to manufacturer.

Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

Dry Ice Gas Converter

615 • Dry ice converters for industries requiring a supply of CO_2 gas are available in four sizes: 300-lb, 600-lb and 1000-lb capacities. They may be installed either vertically or horizontally. The 1000-lb capacity converter stores approximately 8700 cu ft of CO_2 gas which can be withdrawn at rates up to 900 cu ft per hour. To operate the converter, 50-lb blocks of commercial dry ice are inserted into a full opening cylinder and sealed. Once sealed the dry ice begins to convert to a liquid-gaseous state and either gas or liquid may be withdrawn. The converter requires no attention while storing gas.

Dry Ice Converter Corp, Dept C, Box 1652, Tulsa, Okla.

For more data on these items, use post cards p 175. Identify your request with item number.

CHECK THESE TOO . . .

Controlled Closing Valve . . . . . p 180
Warm Air Space Heaters . . . . . p 182
Rotary Selector Switches . . . . . p 184
Vertical Steam Turbines . . . . . p 186
Shut-off Throttle Valve . . . . . p 188
Welding Accessories . . . . . p 192
Oil Bath Air Cleaner . . . . . p 196
Two Circuit Limit Switch . . . . . p 200
Stainless Steel Tubing . . . . . p 204
Hook-on Volt-Ammeter . . . . . p 266

(Advertisement)

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 | JUNE 1954 | Number 3

Process Bottleneck Cleared

Emergency solution of a water quality problem smashed a production bottleneck in a new midwest plant. Temporary measures adopted provided immediate relief, allowing time for design and future installation of permanent deionization equipment without the costly slowdown that would otherwise have been unavoidable.

A critical process operation called for absolutely spotless pipe sections. Although the rigid specifications for cleaning these pipes were carried out conscientiously by the plant personnel, spotting still occurred. Tan and white stains appeared on the internal surfaces when the clean sections were air-dried after a final hot water rinse. Rejections became such a problem that Hall service engineer, R. G. Hobek heard of the difficulty. Sensing that the water supply might be the critical factor, he called on Hall's specialist on metal cleaning, C. T. Roland.

Investigation of the water source and the setup for drying the pipe sections showed that as little as 5 to 10 ppm of dissolved solids in the rinse would show up in stains as the rinse water evaporated from the pipe surface. Available raw waters showed total solids in a range of 350-450 ppm.

As an immediate relief measure, Mr. Roland recommended that the plant install a temporary tank so that steam condensate from various traps in the building could be stored and used as makeup for the hot water rinse tank. In addition, he recommended that the pipe be hoisted from the tanks in such a way that the water would drain in a thin sheet from the surface. The pipe would then dry rapidly and any dissolved solids would deposit only in a small area around the lower ends.

Since condensate might not be permanently available, deionization of the water supply was recommended.

On a follow-up visit, Mr. Hobek found that the temporary changes in procedure had doubled the output of pipe, and that during the two days he observed the operation not one piece of pipe had to be recleaned.

Emergency measures such as those instituted at this particular plant are not always feasible. One way to avoid an unexpected roadblock is to seek advice *before* setting up an industrial operation using water.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Reprints Available

Reprints of "Practical Performance of Water Conditioning Gadgets" by B. Q. Welder and E. P. Partridge of Hall Laboratories are now available. This paper, presented in October, 1953, at the 14th Annual Water Conference of the Engineers' Society of Western Pennsylvania and now reprinted from the May, 1954, issue of Industrial and Engineering Chemistry, reports field observations of the performance of various devices claimed to be effective in treating water by non-chemical means. Write for your copy to Hall Laboratories, Inc., P. O. Box 1346, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Engineer Tracks Down Culprit

When Hall engineer R. D. Hugus recently reported to headquarters on trouble-shooting at a Great Lakes manufacturing plant, his running reports on the job sounded like a popular "whodunit."

First Report

"In response to a call, I visited plant at 10:00 p.m. to see what the trouble was. Two boilers were in service and water level was swinging. Hooked up cooling coil and checked steam samples. Found boilers carrying over severely."

Second Report

"Set up conductivity equipment on two boilers. I could not do a thing with the boilers regardless of whether water level was high or low. Carryover was terrific. Some conductivity values on condensed steam were 1200 micromhos—boiler water was 1800 micromhos.

"Cut off all condensate returns from E section of plant. Blew boilers every fifteen minutes with continuous blowdown valves wide open. Ran over week end this way. Conductivity came down to 4-5 micromhos and has been holding there.

"Checked samples from various points in E section. Found severe contamination at a process point where steam is used for washing parts. Material used in washing contains wetting agent. Condensate from washer will be sent to sewer."

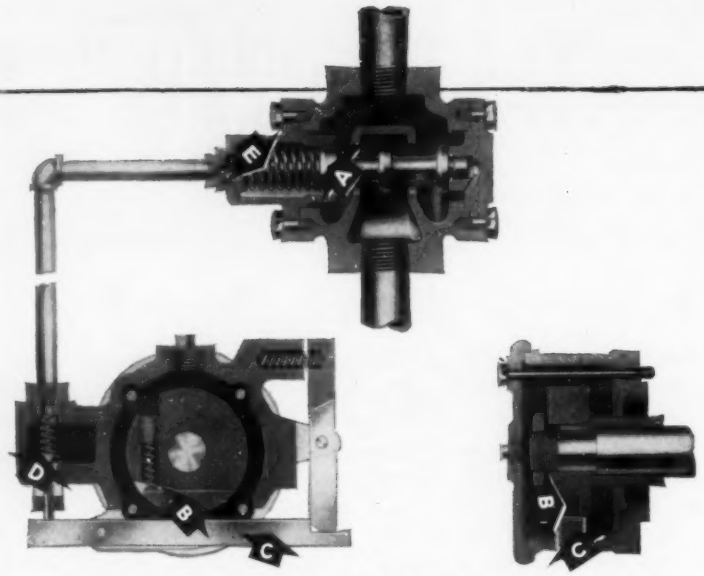
Final Report

"No further difficulty with water level since contamination corrected."

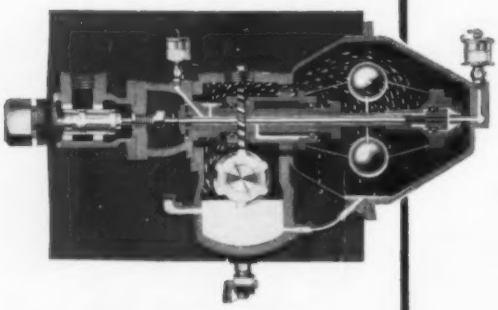
Case Closed

"Water level in boiler now holding steady. Traps in return system also functioning much better. Drastic fluctuations no longer evident. This has been accomplished by bringing back only good quality condensate."

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When turbine is operating, Lever C is horizontal, Pilot Valve D closed, and Valve A held open by Spring E. When excess speed is reached, centrifugal force throws Weight B against Lever C, opening Pilot Valve D. This relieves the pressure back of Valve A, unbalancing and closing it immediately, compressing Spring E and shutting off the steam supply to the turbine. When Lever C is manually reset, Pilot Valve D closes, allowing pressure to build up back of Valve A and thus restoring the balance. Spring E then opens Valve A, admitting steam to turbine.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 166 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here

New free catalogs and bulletins are listed beginning on back of this page! To order those you want, write in their item numbers here

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New York 36, N. Y.

AIR CONDITIONING

1 **Unit coolers** with filter sections for commercial refrigeration. Two-color, 2-page insert for bulletin 104-53. Tenney Engr Inc, 1090 Springfield Rd, Union, N. J.

2 **Compressed air filter** for moisture control. Applications, photos, and complete specs. Four-page bulletin. Van Products Co, 3796 W 12th St, Erie 3, Pa.

3 **Vapor collectors.** Individual unit type for control of vapor and mist. Photos and specs. Single-page bulletin 640 No. 3, Aget-Detroit Co, Ann Arbor, Mich.

BOILERS AND AUXILIARIES

4 **Boiler feed control.** Application photos, schematic drawings and charts. Twelve-page bulletin 1003, Copes-Vulcan Div, Continental Foundry & Machine Co, Erie 4, Pa.

5 **Water tube steam generators,** completely integrated for fully automatic, semi-automatic or manual control. Photos, cutaways and specs. Fourteen-page bulletin MH, Union Iron Works, Erie, Pa.

6 **Air-cooled piers and sills.** Photos and features. Two-color, 4-page bulletin B-54, Bernitz Furnace Appliance Co, 150 Causeway St, Boston 14, Mass.

7 **Water wall armor** for high-temperature service. Photos and specs. Two-color, 8-page bulletin B-52, Bernitz Furnace Appliance Co, 150 Causeway St, Boston 14, Mass.

8 **Feedwater regulators.** Condensed catalog describes complete line of boiler feed regulators, pump governors, desuperheaters, liquid level controls and other equipment. Bulletin 1009, Copes-Vulcan Div, Continental Foundry & Machine Co, Erie 4, Pa.

9 **Oil and gas burners** as applied to industry. Fully illustrated 28-page booklet describes a number of types and sizes of both interchangeable and non-interchangeable burners. Bulletin OB-53, The Engineer Co, 75 West St, New York 6, New York.

CONTROLS

10 **Automatic transfer switches.** Four-page folder describes factors for proper selection. Bulletin 502, Automatic Switch Co, 391 Lakeside Ave, Orange, N. J.

11 **Level and pressure telemeter.** Features, descriptions, photos and diagrams. Eight-page bulletin 230-K10, Builders-Providence Inc, 345 Harris Ave, Providence 1, R. I.

12 **Automatic line transfer controls** and stand-by electric generating plants. Installation specs, diagrammatic drawings. Sixteen-page technical bulletin T-011, D W Onan & Sons Inc, Minneapolis 14, Minn.

13 **Flow regulator.** Self-operated unit maintains constant flow rate by means of energy derived from the flowing stream itself. Photos, cutaways and diagrams. Four-page bulletin 10-F-70, Fisher & Potter Co, 49 Jacksonville Rd, Hatboro, Pa.

14 **Automatic pump sequence controls** satisfies fluctuating demands in multiple pump installations. Four-page bulletin 91-106, Fisher & Potter Co, 49 Jacksonville Rd, Hatboro, Pa.

15 **Gas regulators.** Two-color, 36-page catalog describes complete line. Full specs, photos and operating data. Catalog 806, Air Reduction Sales Co, 60 E 42nd St, New York 17, New York.

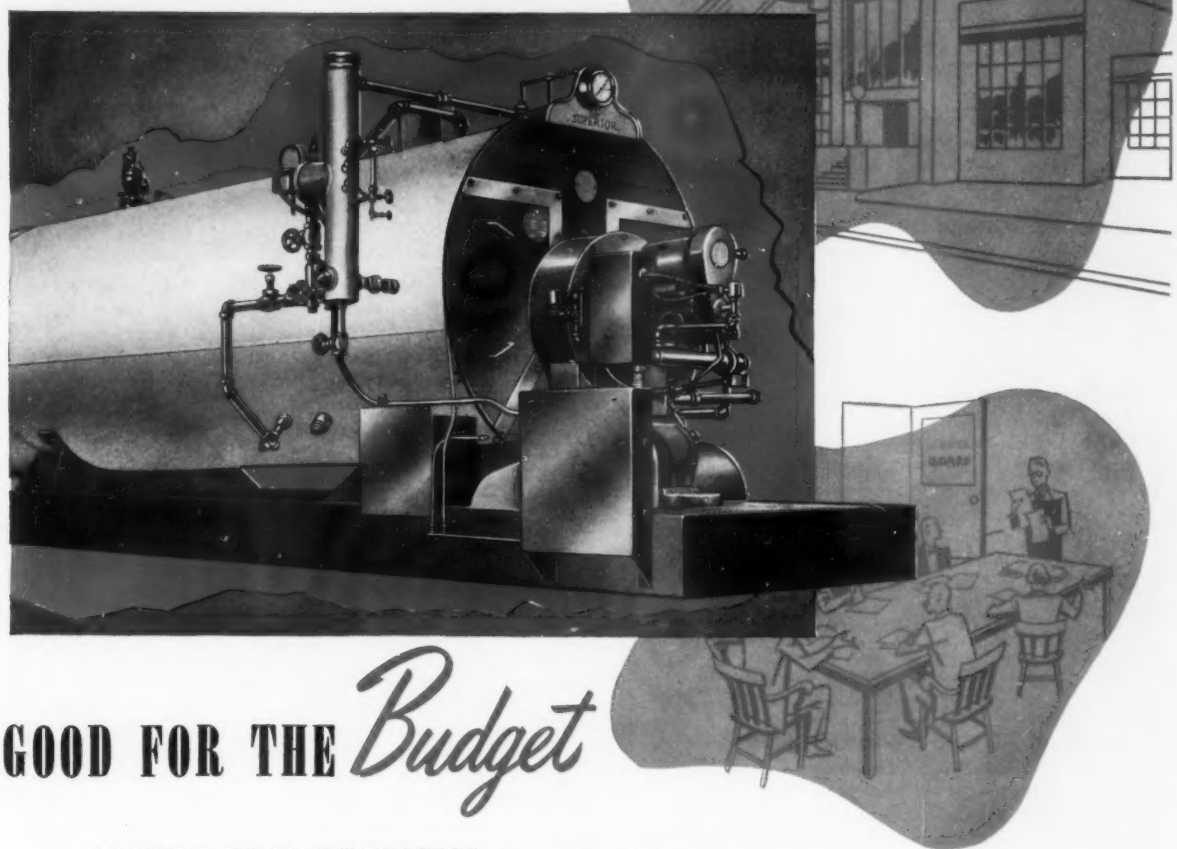
ELECTRICAL EQUIPMENT

16 **Emergency lighting unit.** Photos, diagrams and specs. Two-color, 6-page bulletin. The Electric Storage Battery Co, 42 S 15th St, Philadelphia 2, Pa.

17 **Selenium rectifiers,** both radio and industrial types. Fully illustrated, 24-page bulletin 177, Radio Receptor Co Inc, Sales Dept, 251 W 19th St, New York 11, N. Y.

(Continued on page 238)

GOOD FOR THE *Plant*



GOOD FOR THE *Budget*

SUPERIOR STEAM GENERATORS are the ideal source of steam for heat or process. Completely *factory assembled*, and *factory tested* to insure capacity operation at thermal efficiencies guaranteed to exceed 80%, they are backed by undivided responsibility. Installation is simple and inexpensive. Rugged and compact, they need no special foundation, fit in limited space with low overhead.

Superior's *built-in* induced draft eliminates the need of an expensive chimney and avoids the forcing of combustion gases into the boiler room.

Superior Steam Generators reduce maintenance to a minimum and in many cases earn their total cost in less than 2 years through operating economies resulting from high efficiency.

Dependable, quiet performance, plus economies of installation and operation, make Superior the ideal steam plant.

Fully automatic, Superior Steam Generators burn gas, oil, or both. Sizes from 20 to 600 bhp. for pressures to 250 psi. or for hot water. Battery installations provide maximum flexibility for higher capacities. Write for catalog 600.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

George Edwards' Scrapbook

Daringly yours, Wm H Danforth, reads this autographed photo, showing 82 year old Will Danforth shaking hands with Dick McGurk, POWER district manager in St Louis and Steve Elonka, associate editor, on their recent visit to his plant.

I know of no man who has better right to sign his name this way than does Danforth. Years ago, he dared to start a firm that is known today as the Ralston Purina Mills. His firm has grown into 43 plants and last year did a $440 million business.

Does it pay to advertise? Look at Danforth's tie. He got the checker board trademark idea for his products years ago, when a little boy in Missouri. Farmer Brown came to town with his wife and daughters, all dressed in gingham.

"Those little squares stood out in the crowd so well that I adopted the idea. And I've kept that trade mark before the public and wouldn't consider selling it today for $10 million," he states.

Today, Danforth spends his time meeting visitors whenever time permits. Like many successful men, he has learned the value of good will, whether through advertising or by shaking hands as in this photo.

Interested in succeeding? (Who isn't?) Here are a few items from surveys you might want to know:

1 Men reaching top jobs keep shifting until they find the firm offering most opportunities, says the University of Kansas.

2 Almost all men in top-ranking jobs have gotten there because they are happy with their vocation.

3 You don't have to be a genius to hit the top rung. Many men of average intelligence make the grade because of one quality—persistence.

4 Laziness holds back otherwise brilliant people, finds the Illinois Institute of Technology.

* * *

Karl Marx believed that more machines would mean less work and therefore more economic slavery. Workers would then turn into mere robots, toiling in monstrous factories. While time has shown his theories to be all wet, many people always have been and are still barking up the same old tree.

When a new labor-saving textile machine was invented in England years ago, the inventor saved his life by escaping town. The good townsfolk, all textile workers, descended on his home with clubs because his invention 'would put them out of work.'

When a new power hand-saw was placed on the market a few years ago, Chicago carpenters refused to use it because they 'would be out of jobs.' And so it goes.

Yet, the Chinese go so far in using hand tools that they even saw board from logs by hand. Compare their economy with ours. I'm sure Karl Marx' followers wouldn't care to change from our living standards to those of the Chinese.

Because of all these labor-saving devices, we have time to buy and enjoy automobiles, TV, movies, fishing, shopping and gardening. Instead of working from dawn to dusk, as I did on my first plant job, we have leisure. And this leisure is even used for planning more labor-saving machinery.

It's hard for a power engineer like myself to understand how people able to reason should want to destroy the most highly developed technological nation in the world when there isn't an example of anything half as good anywhere else. If the Commies had a better way, all they'd have to do is lift the iron curtain and let the world see what a 'workers paradise' looks like. Then people would stampede to get there, as they have been doing for years in coming to the United States.

I once knew a man who would figure and plan,
the deeds he intended to do,
But when the time came to get into the game,
he never put anything through.
He would dream with a smile of the after-a-while,
and the deeds he would do "pretty soon."
He was all right at heart, but he never would start—
he never could get quite in tune.
If he would have done half the things he begun,
he'd be listed among those of fame,
But he didn't produce, so he was of no use—
good intentions do not win the game.
It is easy to dream, to plan and to scheme,
and let them drop out of sight,
but the man that puts through
what his dreams bring to view,
is the man who does win the fight.

—EDGAR L JONES

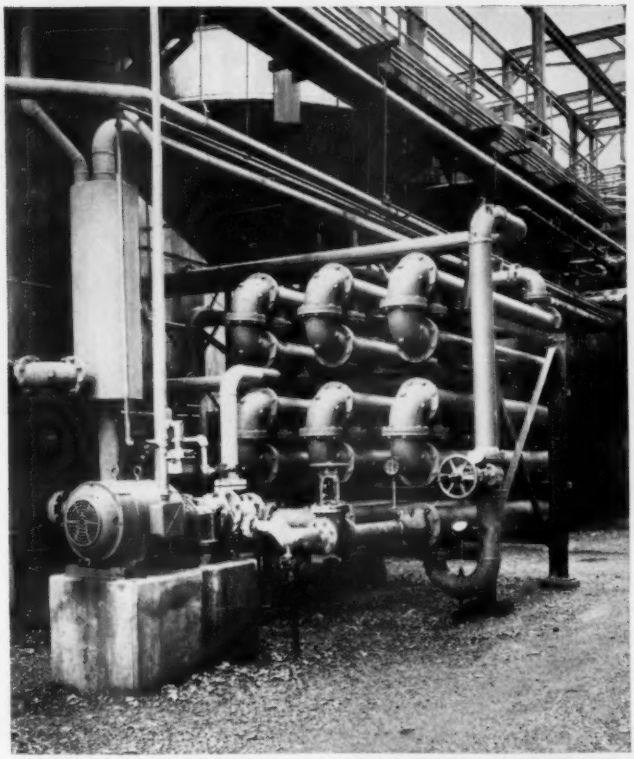
After reading these few lines, I guess I better knuckle down and order that new feed pump I've been planning on for the last four years.

George Edwards
Engineer

Experienced engineers are at your service day and night. They diagnose the trouble, prescribe and administer the cure for maintenance cleaning problems.

NO SHUTDOWN FOR CLEANING

Scale removed chemically from caustic tanks and coolers while units continued to operate. Full capacity restored.



Dowell's specially equipped trucks provide all the necessary equipment for modern chemical cleaning operations. Solvents are applied according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing.

Time and time again Dowell Service has proved that industrial equipment—heat transfer units, boilers, tanks—can be cleaned quickly and effectively with chemicals. Take this case for example. Dowell was called in to clean some caustic cooling tanks and coils for a large chemical company. A reduction in cooling capacity and an increase in input pressure indicated the equipment had become clogged with scale. Sea water had been run through these coils as the cooling agent, leaving iron and chloride deposits.

Dowell engineers pumped specially prepared liquid solvents into the units through regular connections—without dismantling. No scaffolding was necessary. Caustic production was continued during the job. Operations were curtailed only slightly. The tanks and coils were restored to full cooling capacity in less than 18 hours.

Whatever your cleaning problem—piping systems or process equipment—call a Dowell engineer. He will be glad to work with you—no obligation. For consultation, contact your nearest Dowell office or write to DOWELL INCORFORATED, Tulsa 1, Oklahoma, Dept. F-23.

DOWELL SERVICE

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CHLORINIZER keeps 'em clean...

... at Station B of San Diego Gas and Electric Co., this Builders Model HCVS 3000 lb. per day Chlorinizer reduces to a minimum hand cleaning of condensers . . . keeps condenser slime under control throughout the year. To do the job, heavy chlorine dosages are "shot" to 4 points of application: 3 pump suctions and 1 open channel. Chlorinizer, with its simple tantalum diaphragm control valve and hydraulic control system, is ideally suited to this type of automatic time-sequence control. Very slight modification of the basic Chlorinizer (Photo A) was required. The companion-type control panel (see Photo B) is an economical combination of off-the-shelf components . . . easy to adjust or service . . . low in both initial and upkeep costs.

This installation was made in 1952 at the 100,000 KW Station B, and the Chlorinizer and control panel have been in continuous service since then.

Find out how Builders Chlorinizer can solve your slime control problems . . . in main condensers . . . in heat exchangers . . . in all types of cooling systems. Send coupon for complete details.

BUILDERS-PROVIDENCE
DIVISION OF B-I-F INDUSTRIES, INC.
METERS FEEDERS CONTROLS

BUILDERS-PROVIDENCE, INC., 354 Harris Avenue, Providence 1, Rhode Island

☐ Send Application memo 840-J9 describing Chlorinizer slime control system.

☐ Send full details on Builders Chlorinizers.

Name.....

Company.....

Street..... *City*..... *State*.....

More EQUIPMENT NEWS

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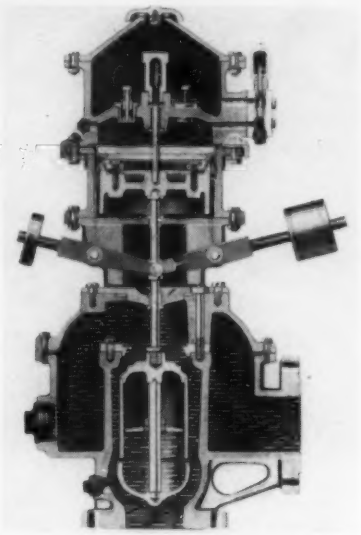


Controlled Closing Valve

607 • Controlled closing valve *type CCAV* has been introduced for protection of pipe lines against effects of surge and built-up pressures or water hammer. It controls speed line closure, vents air and, if necessary, discharges water to prevent damage and also admits air to protect against pipe collapse from line breaks. The valve is furnished with a 4-in. diameter flanged inlet opening.

Simplex Valve & Meter Co, 68th & Upland Sts, Philadelphia 42, Pa.

For more data on these items, use post cards p 175. Identify your request with item number.

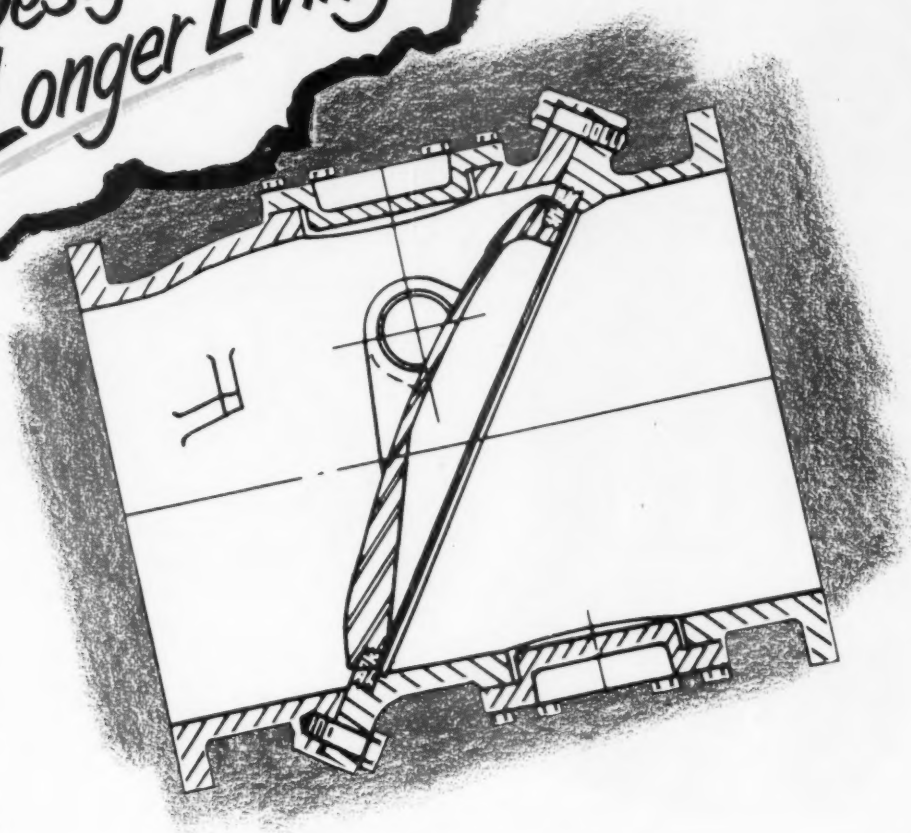
High Pressure Valve

647 • Specially designed and engineered for such service as instrument panels and lines, gauge, bypass and corrosive lines and orifice meters, new 6000-psi stainless steel instrument valve is small, easy to handle and weighs only 2¼ lb. Its space-saving compactness permits close alignment of piping with near structures. Packing gland can be tightened in close quarters and disassembly presents no problem. Units are available in ¼, ⅜ and ½-in. sizes.

Manning, Maxwell & Moore, Inc, 65 Grove St, Watertown 72, Mass.

(*Continued on page* 182)

Design for Longer Living



. . . You find it only in

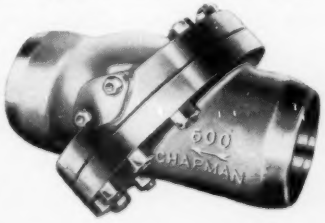
CHAPMAN'S
Tilting Disc CHECK VALVE

Here you can see the specially designed *airfoil section* of the disc in the Chapman Tilting Disc Check Valve . . . and you can see how the disc-seat lifts away from the body seat when opening (and drops into contact when closing) with no *sliding or wearing of the seats.*

Under usual piping arrangements this unique designed disc won't slam . . . just cushions itself to a quiet closing that does not even jar the line.

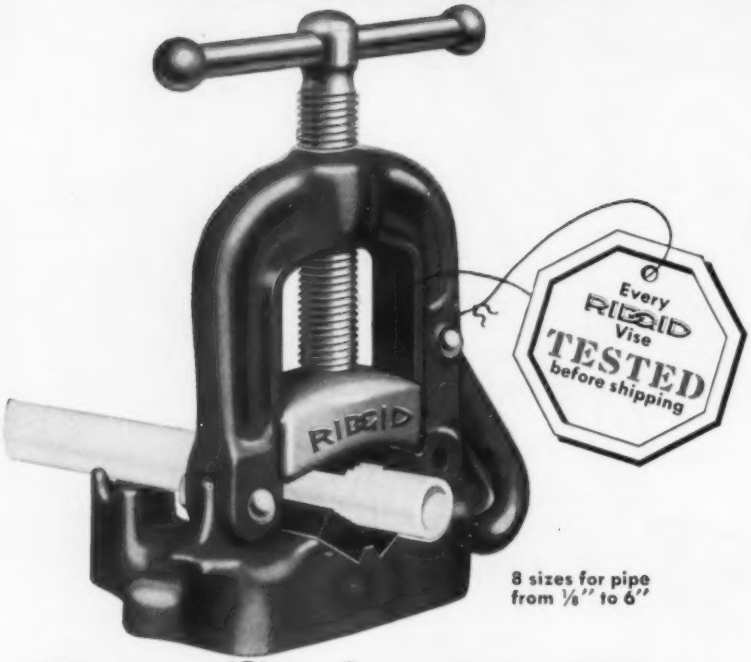
And this balancing is the reason why Chapman Tilting Disc Check Valves greatly reduce head-loss over standard designed swing-type checks . . . as proven by tests in leading engineering schools and by actual performance in the field.

Available in iron or steel. Complete test data is given in Catalog No. 30–write for your copy now.



The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

For Easiest Pipe Work ...it's the New 20 RIDGID



8 sizes for pipe from ⅛" to 6"

More utility for your money in RIDGID Bench Vises

• No wonder this bench yoke vise is popular everywhere! You can make the yoke open for either right or left hand. It has an integral pipe rest for easier cutting or threading . . . built-in pipe bender . . . strong special malleable yoke and base . . . LonGrip jaws of top quality tool-steel. You simply can't beat it for efficient easy operation that lasts for years! Buy it at your Supply House.

RIDGID Chain Bench Vise, ⅛" to 8"

Same work-saver features in RIDGID post, kit and stand yoke vises and bench, post and stand chain vises.

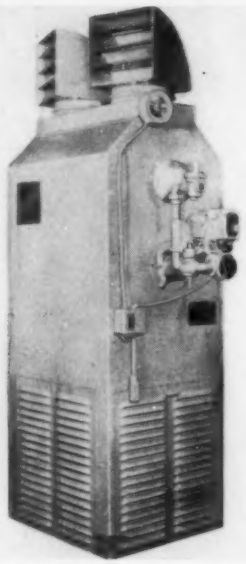
See us at Western Plant Maintenance Show, Booths 639, 643.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

More EQUIPMENT NEWS

Begins on page 166

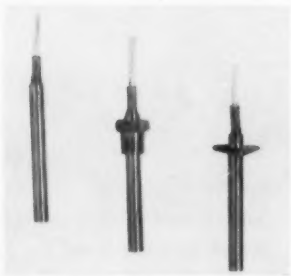


Warm Air Space Heaters

620 • Two new gas fired warm air space heaters have capacities of 200,000 and 250,000 Btu per hour and are suitable for natural, manufactured or mixed gases and liquified petroleum. The self-contained, gun type, flange mounted gas burner incorporates a combustion air fan driven by a ¼ hp resilient mounted motor. It operates on 110 v, 60 cycle, single phase power and is equipped with a thermo-electric safety pilot. Burner features a positive mechanical shut-off valve operated by a centrifugal governor on the motor shaft, pilot safety and electrically ignited gas pilot.

Heating Dept, Machinery Div, Dravo Corp, Pittsburgh, Pa.

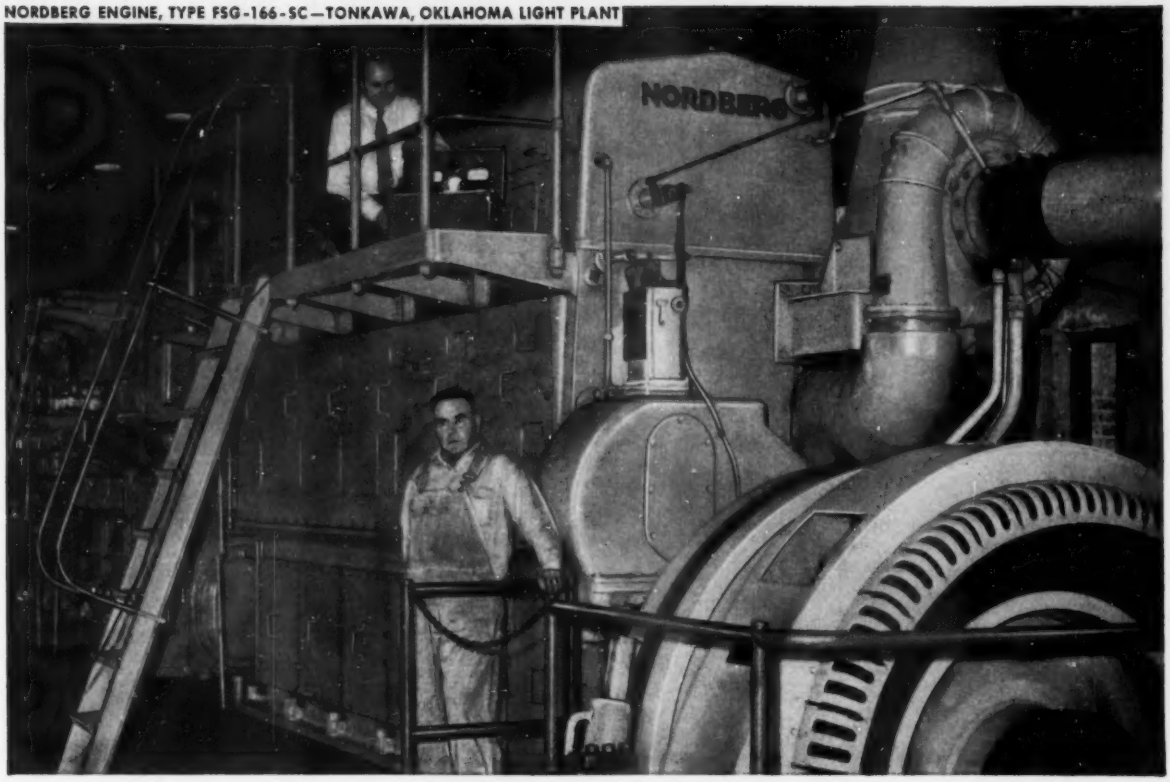
For more data on these items, use post cards p 175. Identify your request with item number.



Midget Thermostat

648 • New series of precision miniature thermostats are ¼-in. dia and only 2⅜ in. long. Because of its unusually small size and double-lead design, midget thermostat may be used (with suitable relay circuit) as precision temperature controller in any heated device where space is closely limited. It may also be used as overheat detector in high-rpm machine bearings, ovens, oil pumps, heater ducts, etc. Unit is preset to actuate at any selected temperature in range of −65 to 450 F. Depending on set

NORDBERG ENGINE, TYPE FSG-166-SC—TONKAWA, OKLAHOMA LIGHT PLANT



30,000 HOURS, NO WEAR!

MICROMETER MEASUREMENTS			
LINER MEASUREMENTS		WITH CRANK	90° TO CRANK
#1 Liner	Top	16.004"	16.008"
	4" down	.003"	.006"
	8" down	.0035"	.007"
#2 Liner	Top	16.003"	16.002"
	4" down	.002"	.001"
	8" down	.001"	.0005"
#3 Liner	Top	16.005"	16.007"
	4" down	.004"	.006"
	8" down	.003"	.008"
#4 Liner	Top	16.003"	16.004"
	4" down	.004"	.005"
	8" down	.001"	.002"
#5 Liner	Top	16.004"	16.000"
	4" down	.003"	.000"
	8" down	.003"	.001"
#6 Liner	Top	16.003"	16.0015"
	4" down	.0015"	.0015"
	8" down	.0015"	.0005"
(Original machine shop tolerance—16" plus or minus .001")			

No Wear On Rings Or Liners With Great Cities Service Diesel Oils!

When the Tonkawa City people pulled this Diesel off the line for periodical inspection, it had logged 30,038 hours and was approximately six years old. After they had the engine torn down, micrometer measurements were taken on the cylinder liners. THEY COULD FIND VIRTUALLY NO APPRECIABLE WEAR ON RINGS OR LINERS!

They were so amazed that they had another man in the plant take his own micrometer readings. Still not certain that an engine could run that long with so little wear, they had the micrometer itself checked! The instrument checked out perfectly!

Men who have worked with Diesel Engines all their lives have said that they've never seen an engine with that much time in service with so little wear. Obviously, a great deal of the credit must go to the maker of these splendid engines, but also, credit must be given to the high-quality, wear-reducing Cities Service Diesel Oils used in this engine. You'd be wise to buy yourself this kind of inexpensive diesel-engine protection too. Call your nearest Cities Service Office or write Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

NEAT AS A PIN

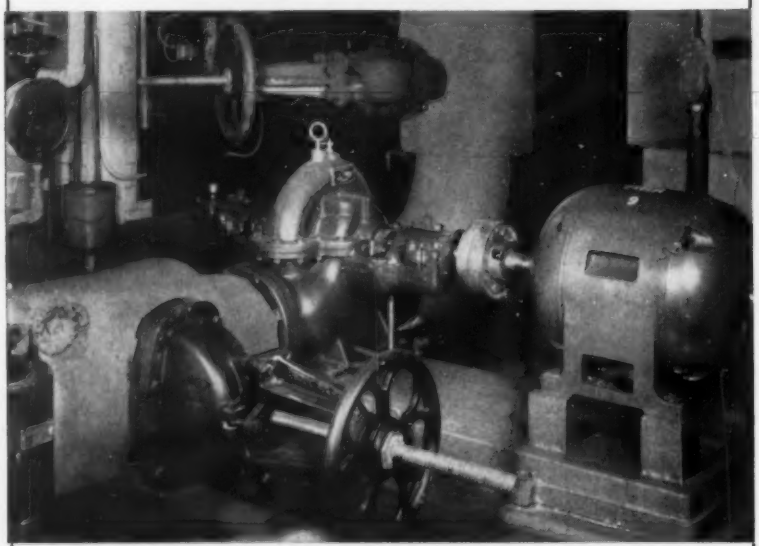
very aptly applies

to the **Power Plant and Air Conditioning** services at

Springfield Fire and Marine Insurance Co.

SPRINGFIELD, MASSACHUSETTS

Not only "neat," but highly efficient, in keeping with this large and progressive organization.



Warren Centrifugal Pump, 1380 g.p.m. on condenser water return from cooling towers

EXPERIENCE is a basic, all-important factor in the insurance business . . . important too, in the manufacture of pumping machinery . . . and so

WARREN PUMPS

with well over half a century of experience in this field exclusively, were chosen for various services, including:

Condenser Water — **Secondary Water to Weathermaster**

Snow Melting — **Primary Chilled Water**

For Power Plant, Air Conditioning and all pumping services, specify:

WARREN QUIMBY PUMPS

P-31

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

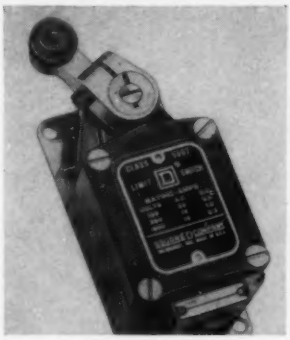
Warren, Massachusetts

More EQUIPMENT NEWS

Begins on page 166

point, it will have an accuracy of 1 to 5 degrees. It is designed for 1-a service at 115 v ac or 32 v dc. Further details available on request to manufacturer.

Fenwal Inc, Ashland, Massachusetts

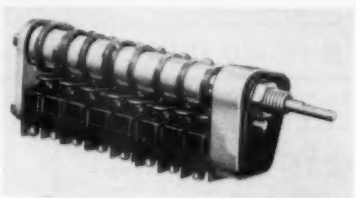


Limit Switch

649 • New heavy-duty limit switch permits easy adjustment of the basic device to obtain eleven different contact operating sequences—with only a screwdriver. Variety of operating levers can be mounted in any position. Although only small travel is necessary for operation, overtravel to about 80° is allowed in either direction. For complete details write for bulletin SM-239.

Square D Co, 4041 N Richards St, Milwaukee 12, Wisconsin

For more data on these items, use post cards p 175. Identify your request with item number.



Rotary Selector Switches

650 • New series of subminiature rotary selector switches offers means of switching as many as eight different circuits with one compact assembly. Equipment is available with from two to eight switching units and from two to eight detent positions with 45-degree angle between detents. Virtually any switching sequence is possible.

Units are available with drilled, solder-type terminals or wrap-around type turret terminals. They are rated for inductive load of 3 a at 30 v dc and 10 a at 125 or 250 v ac. Because of their small size, these switches are especially useful on reversing circuit applications where space is at a premium. Full details available on request.

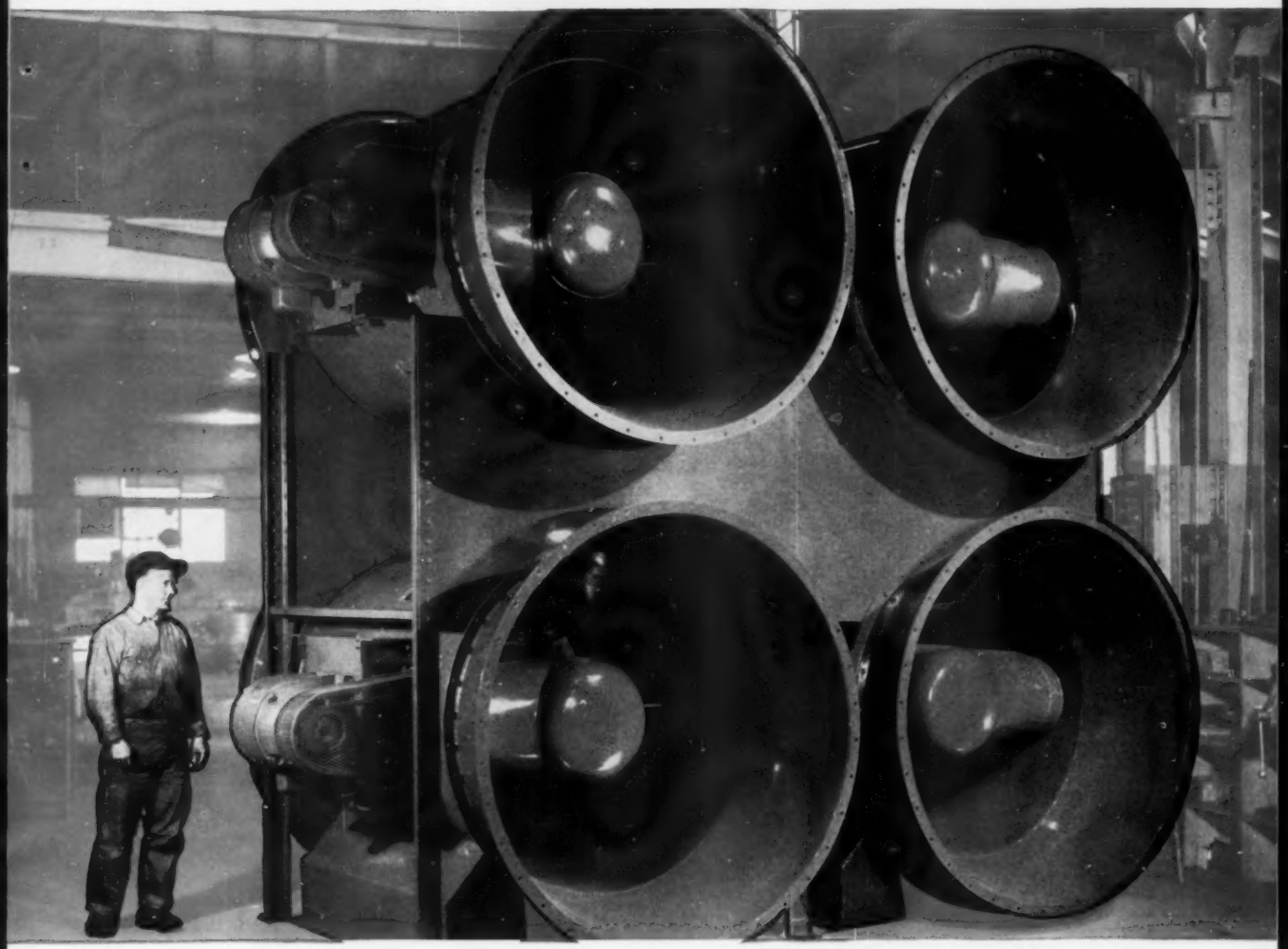
Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Phila. 44, Pa.

Magnetic Pulley

651 • Permanent magnetic pulley, installed in coal conveying equipment, removes tramp iron from processing line. Powerful *Alnico V* magnetic elements maintain constant-strength field across entire

excess

TAKING THE ∧ HEAT OFF THE POWER PLANT!

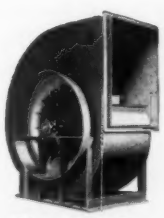


Compact Unit Exhausts 180,000 CFM from Large Power Plant

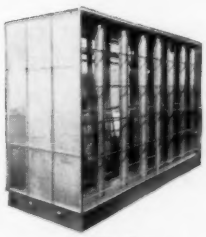
This "Buffalo" Unit in a prominent eastern power plant building is made up of four 54" Type "B" Vaneaxial Fans, each handling 45,000 cfm at 1¼" static. Size of unit is 15' x 12' x 8' thick including motors and drives, and is suited for use in existing buildings. You can install "Buffalo" Axial Flow Fans in minimum space for high-efficiency, high-velocity cooling action. Full range of sizes. Write for Bulletin 3533-C.

A "Buffalo" UNIT FOR YOUR COMFORT COOLING JOB!

"Buffalo" Type "BL" Limit-Load Ventilating Fans offer you a range of 1000 cfm to 500,000 cfm in exceptionally quiet, efficient, stable delivery for ventilation and air conditioning supply—described in Bulletin F-100. "Buffalo" also builds Heavy-Duty "NV" Propeller Fans in capacities from 5,000 to 150,000 cfm, as well as a complete line of Air Cleaning and Air Cooling Equipment. Write us today for literature on comfort cooling for your power plant!



Type "BL" Fan



Air Washer

"Buffalo"

BUFFALO FORGE COMPANY

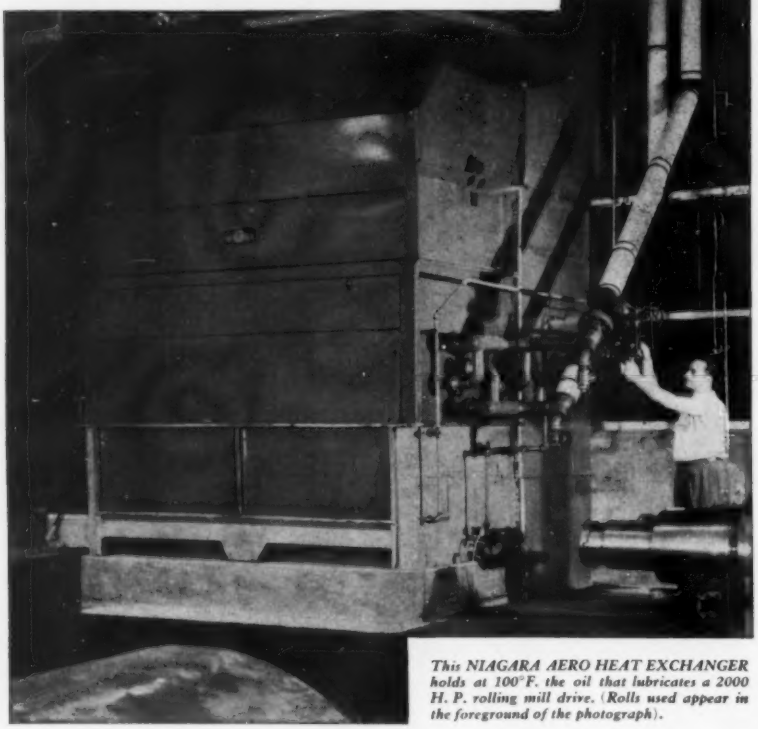
488 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT FORCED DRAFT COOLING HEATING PRESSURE BLOWING EXHAUSTING

YOU CAN KEEP ACCURATE CONTROL OF LUBE OIL TEMPERATURE



This NIAGARA AERO HEAT EXCHANGER holds at 100°F. the oil that lubricates a 2000 H. P. rolling mill drive. (Rolls used appear in the foreground of the photograph).

The Niagara Aero Heat Exchanger uses atmospheric air to cool liquids and gases by evaporative cooling, removing the heat at the rate of input, controlling temperatures precisely. You save 95% of the cost of cooling water. You get great saving in piping, pumping and power, quickly getting back the cost of the installation.

You can cool and hold accurately the temperature of all fluids, air and gases, water, oils, solutions, chemicals for processes and coolants for mechanical and electrical equipment. You can cool welding machines, hydraulic and extrusion presses, plastic molds, furnaces, controlled atmospheres, quench baths, obtaining better results with precise temperature. You obtain closed system cooling, free from dirt or scale.

For further information, write for Bulletin No. 120

NIAGARA BLOWER COMPANY

Dept. P, 405 Lexington Ave. New York 17, N. Y.

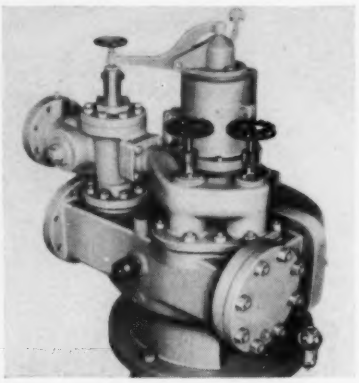
Niagara District Engineers in Principal Cities of United States and Canada

More EQUIPMENT NEWS

Begins on page 166

face of pulley. In operation, pulley exerts force through belt to hold tramp iron on conveyor while non-ferrous material falls clear. Available in wide range of standard dimensions and capacities, pulleys operate equally well through belts of rubber, canvas, leather or other non-magnetic material. Further information from manufacturer.

Eriez Mfg Co, Erie, Pennsylvania



Vertical Steam Turbines

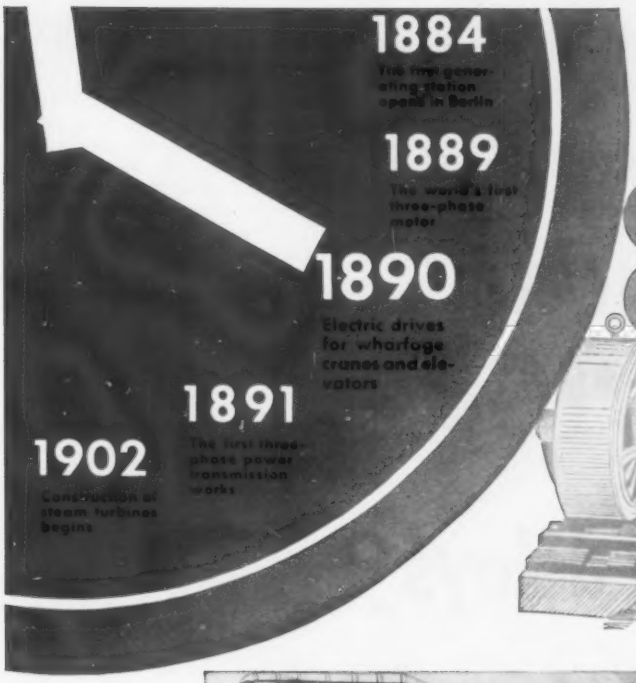
627 • Addition of a steam nozzle to all models of *DH Vertical Line* adds 100% more power to *models DH-10V* and *DH-20V*, according to the manufacturer. *Model DH-30V* now has three steam nozzles, is said to produce 50% more power. Two hand valves improve regulation of water rate at reduced loads. Improved packing boxes check steam pressure leakage and permit higher working exhaust steam pressure. Information on vertical and horizontal turbines available in catalog 500.

Dean Hill Pump Co, Dept 10, Indianapolis 7, Ind.

For more data on these items, use post cards p 175. Identify your request with item number.

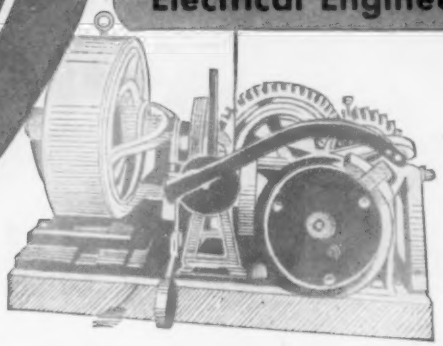
Packaged Combustion Unit

634 • Packaged combustion system is designed to meet heating and power needs of industrial and commercial plants capable of making oil burner or oil and gas burner installations on new or existing boilers with their own maintenance crews. Unit, with all necessary controls and accessories, will convert any standard fire tube or water tube boiler, from 20 to 525 bhp maximum rating,



AEG

and the first hours of Electrical Engineering



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for wharfage cranes and elevators

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AEG means Electricity

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Berlin (Brit. Sector) Export Department Frankfurt (Main)

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Do This Now—

Examine your motors, hose, and couplings, and check your stock of heads and brushes. Let our trained mechanics make any necessary adjustments. Do it now, and they'll be ready when you need them.

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ELLIOTT COMPANY-ROTO DIVISION

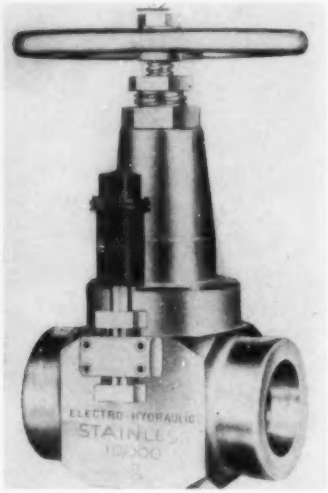
153 Susset Ave. • Newark, N. J.

More EQUIPMENT NEWS

Begins on page 166

to automatic oil-fired or combination oil and gas fired operation, using heavy fuel oil requiring preheating. Complete information available on request to manufacturer.

Preferred Utilities Manufacturing Corp, 1860 Broadway, New York 23, N. Y.

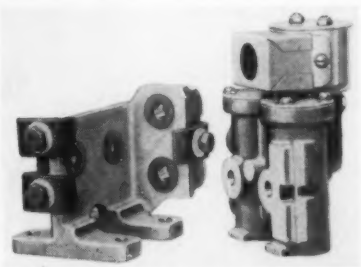


Shut-off Throttle Valve

623 • Welded construction, forged steel shut-off throttle valve is claimed to be 75% smaller in size and weight than cast steel valves. Designed for high pressures and temperatures it is available in sizes from 2 to 20 in. Throttle valve is opened or shut by solenoid operated pilot valve. Full details on request to manufacturer.

Hoppe Engineering Co. Inc, Greensboro, Ind.

For more data on these items, use post cards p 175. Identify your request with item number.



Crescent Valves

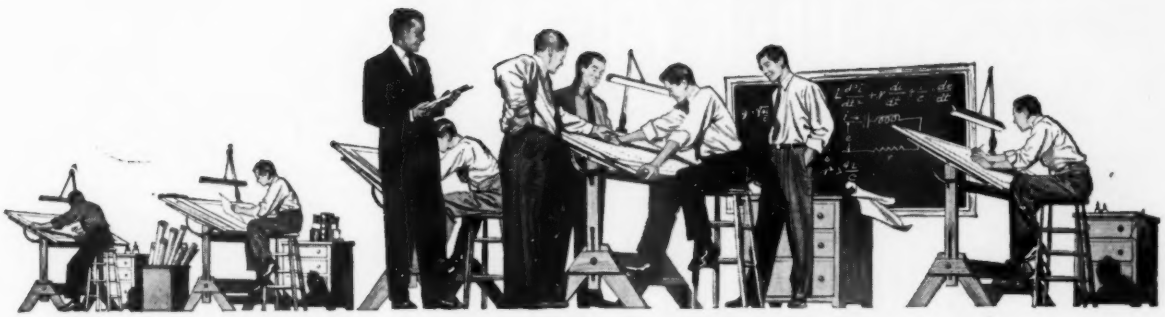
632 • On production equipment, where maintenance down time is costly, this valve can be replaced in seconds, according to manufacturer. By loosening three holding clamp bolts the valve body can be removed and replaced. The sub-base remains as a permanent part of piping. The valves are crescent design, pilot-operated solenoid-controlled four-way valves, for air, light oil and water, pressures to 150 psi. Bulletin 1047 gives details.

Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.

(*Continued on page* 190)

GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE



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ASK THE MEN WHO KNOW

BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

At General Cable our engineers devote themselves as much to customers' wire and cable problems as they do to the design and manufacture of the products you buy.

We would like you to think about this engineering service next time you face a wire or cable problem.

You see, our engineering staff is recognized as one of the industry's most authoritative groups of its kind. Ready at any time . . . to go anywhere, General Cable engineers can assist you in the solution of any electrical wire or cable problem . . . can quickly recommend and provide the most practical product for the job at the least possible cost.

So—on any problem—transmission, distribution, power, control, lighting, or electrical equipment, check General Cable first. You'll be dealing with the men who know.

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Golden-Anderson
Cushioned
Boiler Non-return Valves
and
Steam Check Valves
in sizes
2" through 30"
are now
Available from Stock
IN MOST SIZES
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DESIGNERS AND MANUFACTURERS OF:
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Float Valves • Pressure Reducing Valves • Surge Relief Valves for air, gas, steam and water

More EQUIPMENT NEWS

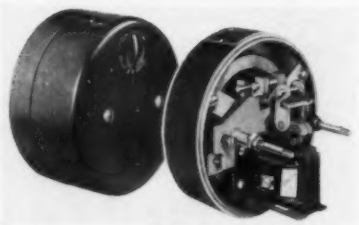
Begins on page 166

Reverse Flow Valve

625 • Hermetically sealed, manually operated four-way reverse flow valve for air conditioning units is designed for ¾- and 1-ton heat pumps. Installed in the heat pump, valve acts to reverse the flow of the refrigerant, causing the appliance to throw off heated air instead of cooled air, or vice versa. Valves measure 1⅝x5¾-in. including the connecting tubes.

Bridgeport Thermostat Div, Robertshaw-Fulton Controls Co, Bridgeport, Conn.

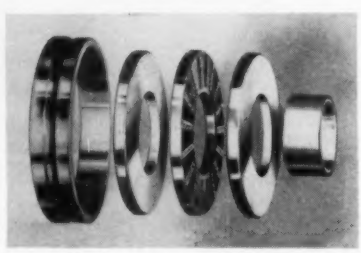
For more data on these items, use post cards p 175. Identify your request with item number.



Magnetic Disc Brakes

631 • Magnetic disc brakes, *40* and *50 series*, are designed to meet NEMA frame standards for FHP motors. The *40 series* for NEMA frame standards in the 1/20 to 1/3 hp range is 5 in. in diameter, less than 3½-in. long and has a torque range of 6 lb-in. to 1 lb-ft. The *50 series* brake for re-rated NEMA frames in the 1/6 through 2 hp motor range is available in 1½, 3, 6 and 9 lb-ft torque ratings.

Stearns Magnetic Inc, Milwaukee 46, Wisconsin



Thrust Roller Bearing

652 • Modified worm-gear thrust roller bearing features one-piece high-tensile sleeve of cast iron. This type of thrust bear-

HOW ACCURATELY DO YOU MEASURE

EXCESS AIR

IN YOUR FLUE GAS?

Prevent heat loss up the stack. Too much or too little excess air means big money in today's boiler plant. It's important to *know* and *control* excess air exactly—regardless of load or fuel changes.

Burn multiple fuels efficiently

When switching from one fuel to another or burning more than one fuel at the same time, only an Oxygen Recorder gives you an undistorted picture of excess air. It measures O_2 directly and continuously, without recalibration.

Hundreds of companies are reaping large savings with Hays Electronic type Oxygen Recorders in their boiler plants. Flue gas sampling systems fit a wide variety of installations.

With the Hays Electronic type Oxygen Recorder you get continuous, highly accurate indication and recording . . . complete compensation for temperature and pressure effects . . . freedom from chemicals or hazardous fuel burning in the analyzing process . . . swift, sure electronic operation.

Write today for Hays Bulletin 52-829-56. Also ask for a dramatic comparison graph which shows that the relationship between O_2 and excess air is practically constant for different fuels.

Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
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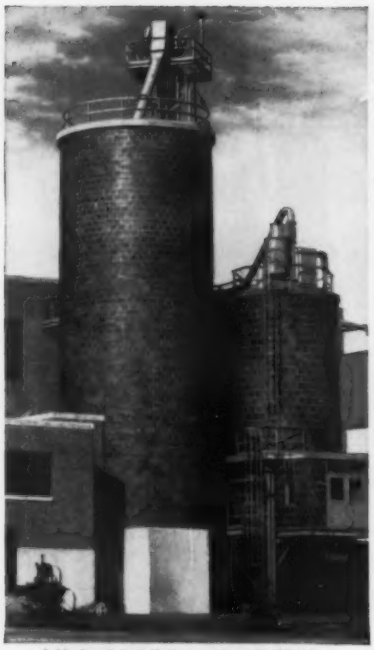
THE hays CORPORATION

MICHIGAN CITY 3, INDIANA



A National Installation at the MEMORIAL HOSPITAL in Westville, Indiana

turn the
EXPERIENCE
OF OTHERS
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Many important engineers have learned that National Ash Conveyor Systems save money. A survey of your own plant will cost you nothing but it may result in cutting *your expenses* as it has *the plants listed.*

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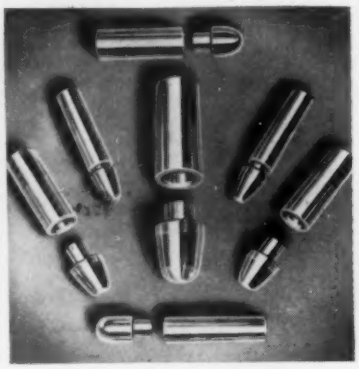
FAIRVIEW, NEW JERSEY
Manufacturers of The National ChipVeyor System For Metal Turnings – Furnace Doors – Feeders – Ash Gates and Related Equipment.

More EQUIPMENT NEWS

Begins on page 166

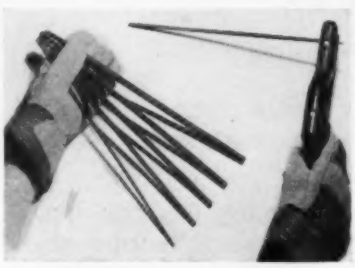
ing is especially suitable for use in worm-gear assemblies or reducers in which thrust direction is reversed frequently. In this bearing, one plate rotates and the other is stationary. When load reverses, stationary plate rotates and rotating plate becomes stationary. Rated load capacities at 10 rpm are from 10,750 to 1,170,000 lb; at 100 rpm capacities range from 4975 to 543,000 lb.
Rollway Bearing Co, Inc, Seymour St, Syracuse, New York



Welding Accessories

653 • New recap tips and adapter shanks provide double water seal and are made of high-conductivity alloys. Welding face of tip can be ejected easily without removing entire electrode from holder. These inserts can be used in dies and in restricted places where clearances are too small for standard tips. Full details available on request.
Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wisconsin

For more data on these items, use post cards p 175. Identify your request with item number.



Hardfacing Electrodes

630 • Iron-base dc hardfacing electrodes have new metallic coating that provides improved weldability and arc stability, according to the manufacturer. The chromium, boron and iron composition electrodes are available in two types: *Colmonoy No. 1* and *Colmonoy Special No. 1* for hardsurfacing applications where extreme impact with high abrasion resistance is required. Electrodes can be used where the deposit must be welded on vertical surfaces. Both types available in 1/8, 3/16 and 1/4-in. diameter sizes. Full details from manufacturer.
Wall Colmonoy Corp, 19345 John R St, Detroit 3, Mich.

(Continued on page 196)

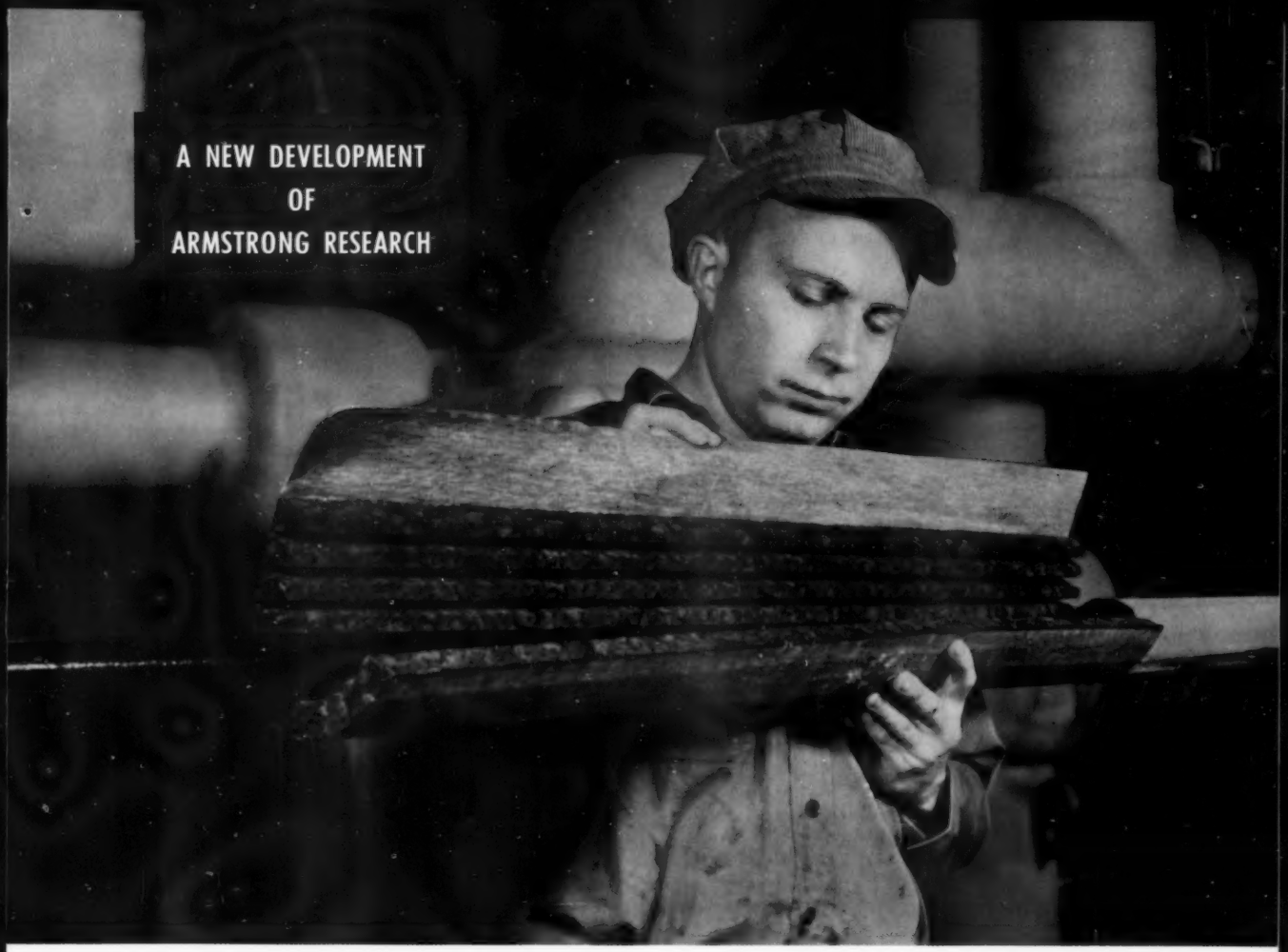
INDUSTRIAL
Air Moving

FAST
ECONOMICAL
TROUBLE-FREE

Peerless PVB

• Peerless PVB Industrial Exhaust Fans are designed for low initial cost and continuous trouble-free duty. Complete ball-bearing construction with totally enclosed motor permits vertical or horizontal mounting. Peerless PVB's move air fast and may be used with ducts. They are sized with 24" to 48" fans. Pulley adjusts for lower fan speeds. Shutters and pent-houses also available. Your Peerless dealer can help you select the best PVB for your needs. If you don't know him — write, wire or call us.

Peerless-Electric
THE PEERLESS ELECTRIC COMPANY
FAN AND BLOWER DIVISION
1417 W. MARKET ST. • WARREN, OHIO



LT-30 cork covering... *a new kind of pipe insulation for dual temperature lines*

Here's a brand-new insulation that offers the high efficiency, strength, and long life of molded cork covering, yet can be installed at much lower cost.

This new material, LT-30 Cork Covering, is fabricated from precision-cut sections of Armstrong's Corkboard, bonded to a special three-ply vaporproof paper. It's used on dual temperature air-conditioning lines, chilled water, and other cold lines. LT-30 prevents sweating under normal conditions where liquid temperatures in the line are 30° F. or above. On hot water cycles, it withstands temperatures up to 200° F.

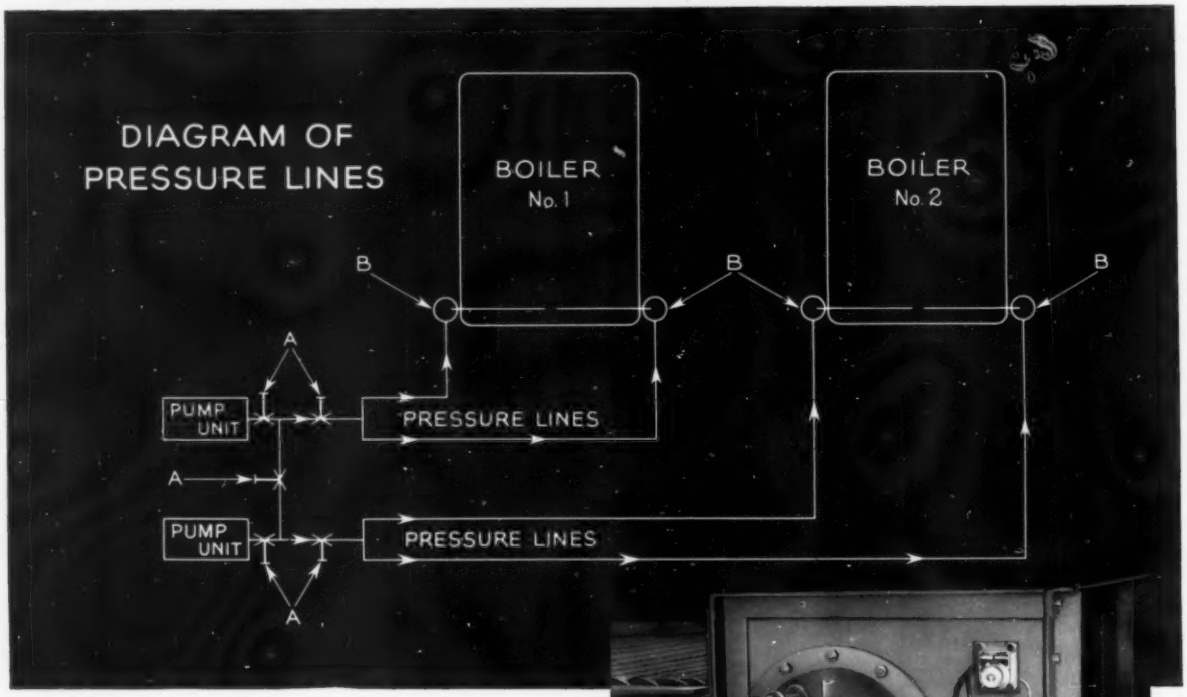
Application is fast and easy. Simply apply LT-30 Adhesive to an overlap, hold the covering around the pipe, and press the lap in place.

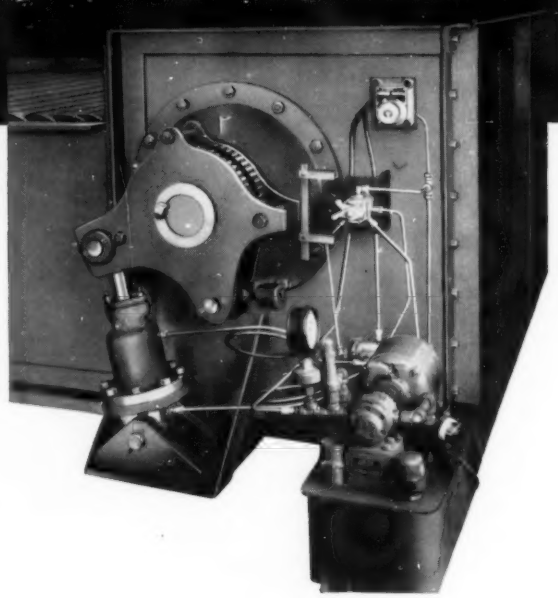
LT-30 Cork Covering is another product of Armstrong's continuing efforts in the laboratory and in the field to improve insulation materials and application methods. For further details on LT-30 Cork Covering, as well as on Armstrong's regular line of molded cork covering, and other industrial insulations, call your nearest Armstrong office or write Armstrong Cork Company, 202 Stratton Street, Lancaster, Pennsylvania.

After the covering is wrapped around the pipe, joints are sealed by strips of LT-30 Paper. There is no need for a further indoor finish, but where color identification is desirable, Armstrong's Insulcolor may be applied.

ARMSTRONG'S INDUSTRIAL INSULATIONS

PERFECT SPREAD STOKER





permits hydraulic
dual grate drive
for maximum dependability

ALL Continuous Ash Discharge Perfect Spread Stokers can be driven by a single power unit. The fluid power pump feeds cylinders "B" on both sides of the grate. This hydraulic system makes it easy to interconnect two stokers and provide for *dual drive* . . . assurance of uninterrupted service in an emergency as one pump will drive both grates by opening or closing valves "A" (See diagram).

In addition, the AE hydraulic drive assures smooth operation, requires less power and maintenance, and gives an infinite choice of speeds from zero to maximum. Automatic overload protection built in. Complicated and aisle-blocking reduction gears are eliminated. The pumping unit can be located next to the stoker or at any convenient place in boiler room or basement.

Write for full information about the AE Perfect Spread . . . the stoker that provides true, continuous feeding of 50 to 7500 lbs. of coal per hour per feeder and never clogs, *not even on wet coal.*

AMERICAN ENGINEERING
COMPANY
2400 ARAMINGO AVE., PHILADELPHIA 25, PA.
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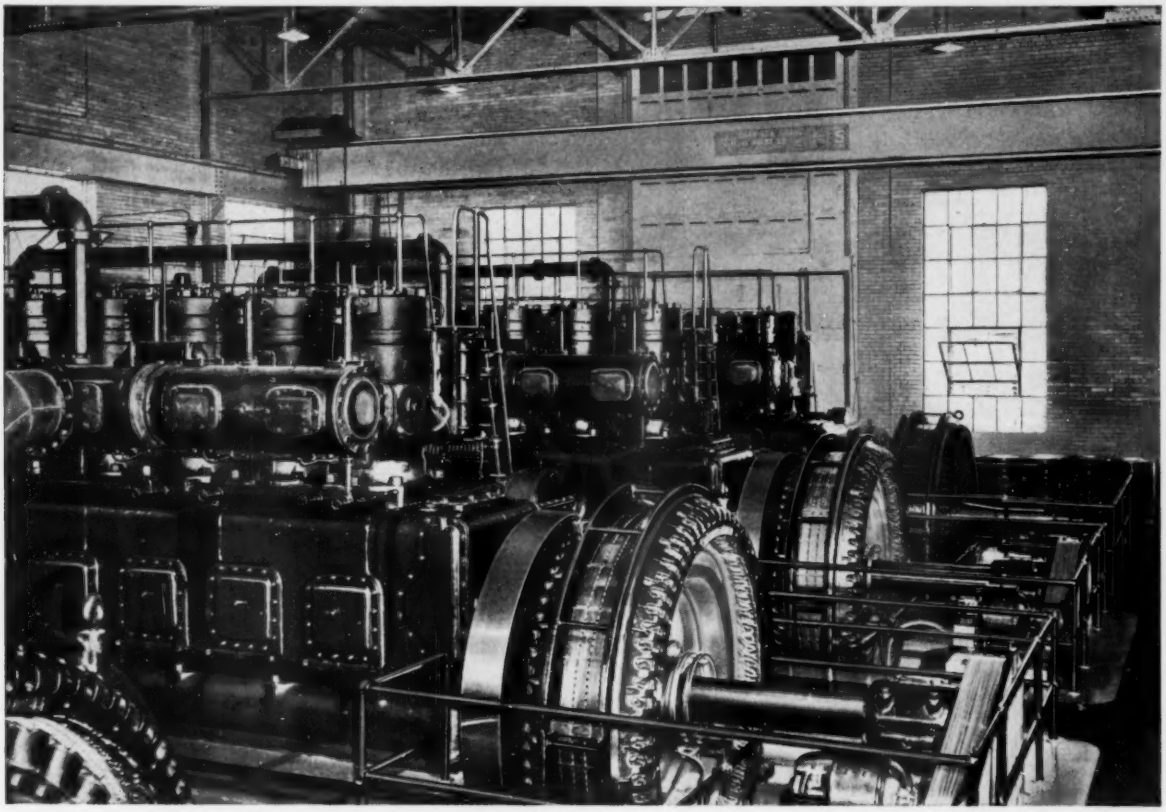
AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.



"We're Proud of This Plant!"

says Don H. Decker, — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

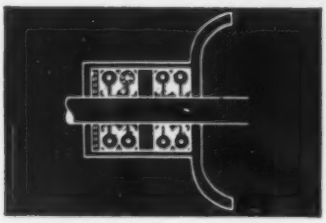
Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity.* Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

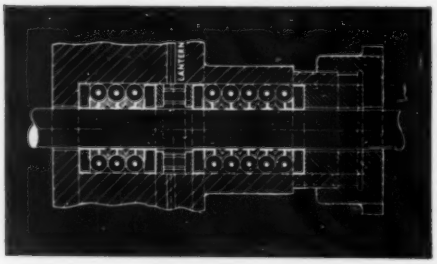
SINCLAIR DIESEL LUBRICANTS

save Wear and Replacement



Chesterton 444 is full metallic on rod or shaft. It runs frictionless without usual gland pressure. Why? It's due to E-L-A-S-T-I-C back and *built-in oil seal* in each Metallic ring. These special metal rings are soft enough to machine themselves to rod imperfections. 8 to 10 years uninterrupted service is common with Chesterton 444.

Chesterton 444, formerly Austin-Mason, is the most famous name in refrigeration packing. Easy to install — each ring is cut so it may be opened to fit over rod or shaft. Full directions accompany every set. Unexcelled for Ammonia, Freon, CO_2, steam, brine, air and other liquids and gases.



Chesterton 444

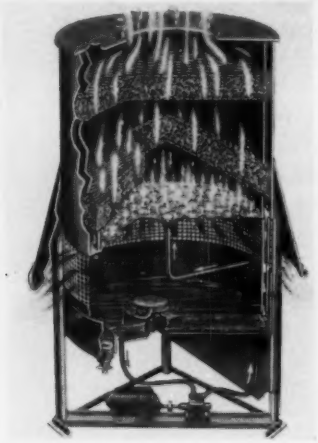
PACKING Chesterton SERVICE

A. W. CHESTERTON CO.
6 ASHLAND ST., EVERETT 49, MASS.

AMERICA'S OLDEST MANUFACTURER OF MECHANICAL PACKINGS

More EQUIPMENT NEWS

Begins on page 166



Oil Bath Air Cleaner

636 • Low resistance oil bath air cleaner for engines using turbo-chargers or pressure blowers for scavenging introduces the perforated entrainment plate principle. By use of this entrainment plate it is claimed that a uniformly high cleaning efficiency can be obtained in an operating range from as low as 10% up to full rated capacity, and at an overall resistance in the order of 2" wg. Available in eight sizes and a capacity range of from 1100 to 21,000 cfm. Bulletin 160-A.

American Air Filter Co Inc, Louisville 8, Ky.

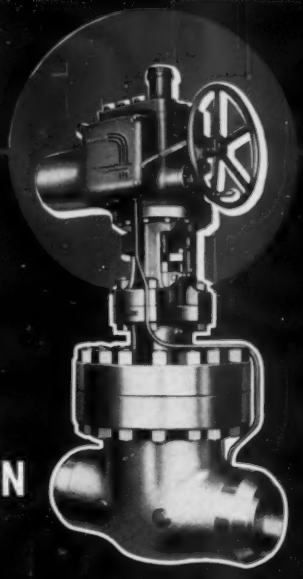
For more data on these items, use post cards p 175. Identify your request with item number.

Small Control Drive

617 • Pneumatically-operated control drive regulates gas and liquid flow of butterfly valves, dampers, feeders, etc, on a straight-line flow characteristic. Pneumatic signal actuates a relay which in turn positions a piston operated drive lever arm. Three different characteristic cams are supplied and may be shaped if necessary. The drive has a 4-in. piston stroke at a torque of 75-ft lb and operates on standard SAMA signal ranges 3-15 and 3-27 psig. Product specs CAO40 and CA942-B available.

Bailey Meter Co 1050 Ivanhoe Rd, Cleveland 10, Ohio

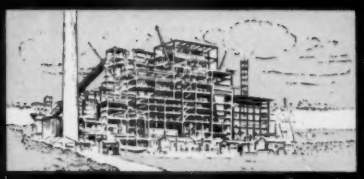
(Continued on page 198)



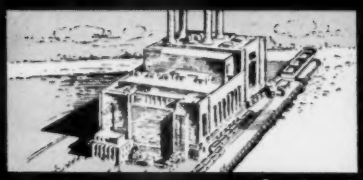
DEPENDABLE, SAFE AUTOMATIC OPERATION

. . . keeps power plants sold on *Limitorque*®

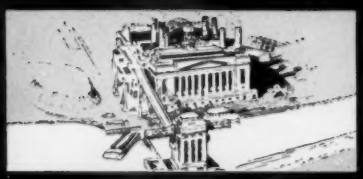
NEW OR EXPANDED PHILADELPHIA ELECTRIC POWER PLANTS



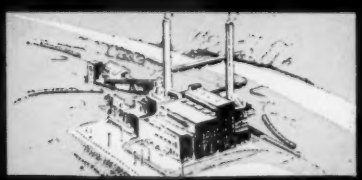
Cromby



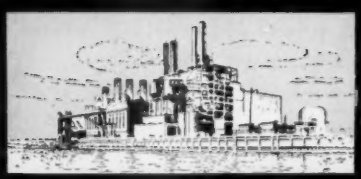
Southwark



Richmond



Barbadoes



Delaware

PHILADELPHIA ELECTRIC COMPANY, one of America's Great Public Utility Organizations, has installed a total of 347 LimiTorque Motorized Valve Operators in seven of their famous Power Stations (5 of which are illustrated herewith).

LimiTorque Valve Controls were chosen for their absolute dependability; speed of operation; saving in man-hours; out-of-the-way or hazardous location of valves;—and of course, for their automatic, positive remote operation by the "mere push of a button". What's more, LimiTorque absolutely prevents damage to valve stems, seats, discs, plugs or gates, . . . because the power is cut-off automatically should an obstruction be encountered in closing.

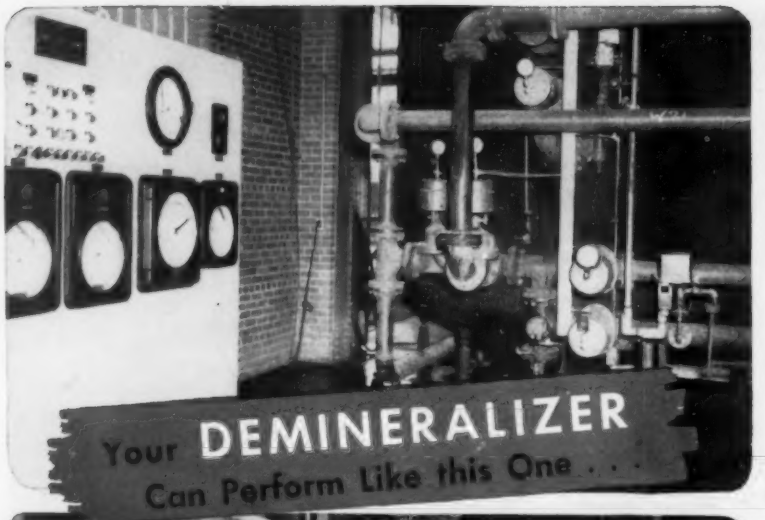
Thousands of LimiTorque Valve Operators are used in many prominent Central Stations; Power Plants; Water & Sewage Plants; Oil Refineries and Pipe Lines; Paper & Pulp Mills, and on Shipboard. Remember, far more LimiTorques are in use today, than any other make of Valve Operator. If you have a valve operating problem,—write us—and a Philadelphia Engineer will gladly call. Literature sent upon request.

PHILADELPHIA GEAR WORKS, INC.

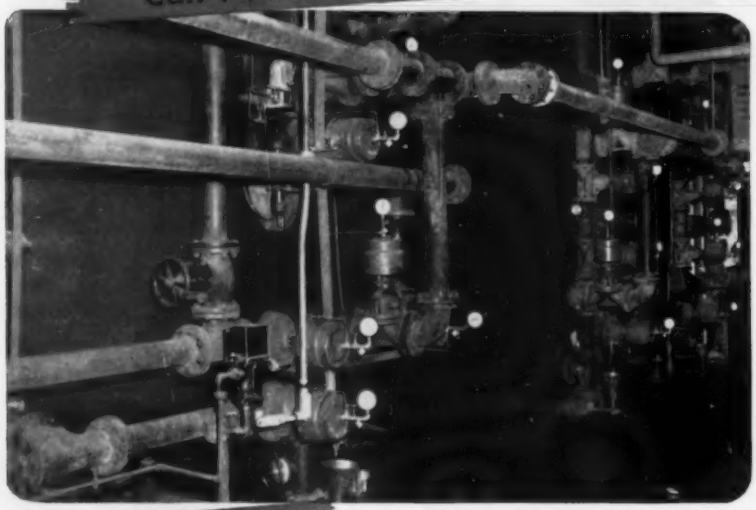
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls



Your DEMINERALIZER Can Perform Like this One . . .



with Nalcite HCR

HIGH CAPACITY
HIGH TEMPERATURE
ION EXCHANGE RESINS

500 gallons per minute of clarified Missouri River water are completely deionized for 100% make-up to a 1250 psig boiler by this Nalcite-charged unit at a large Midwestern utility. Whether your water conditioning problem is large or small, Nalcite HCR cation exchange resin, together with either Nalcite SAR or SBR anion exchanger gives you performance that means longer on-line operation, with removal of both strong and weak acids including silica.

Full information on Nalcite Ion Exchange Materials is yours for the asking. Write today.

*Reg. Trademark of the Dow Chemical Company

Nalco®

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

PRODUCTS • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.*

More EQUIPMENT NEWS

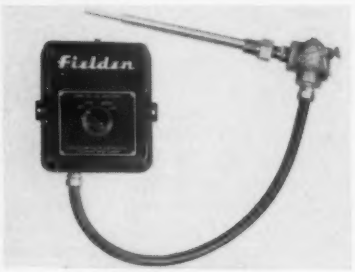
Begins on page 166

Linearity Checker

654 • *Lin-A-Chek* is a practical lineraity checker for testing instruments where precise electrical measurements are required. Device may be used for determining linearity of all types of indicating instruments such as ac or dc voltmeters, dc milliammeters, galvanometers and recorders. Full details and specs available in manufacturer's bulletin A14.

Micrometrical Development Corp, 2821 S State St, Ann Arbor, Mich.

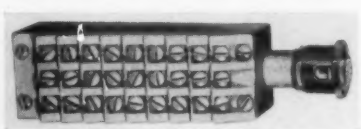
For more data on these items, use post cards p 175. Identify your request with item number.



Dc Amplifier

655 • New series 80 dc amplifiers convert low level dc microampere or millivolt inputs to high-level dc current output. Incorporating high-gain feedback loop, new amplifier has exceptional long and short term stability characterization. It is suitable for many laboratory applications involving measurement or recording of low-level dc signals, and has also been designed for industrial use, particularly as a thermocouple amplifier.

Robertshaw-Fulton Controls Co, Fielden Instrument Division, 2920 N 4th St, Phila. 33, Pa.



Double Throw Switch

640 • New 8-pole double throw switch gives positive control of 8 primary circuits. It may be applied to stop carriers, release machine loads, stop or start machines, shut off boiler feeds, dump fuel or start extinguishers. Constant contact pressure 4-oz. per point, is maintained throughout the

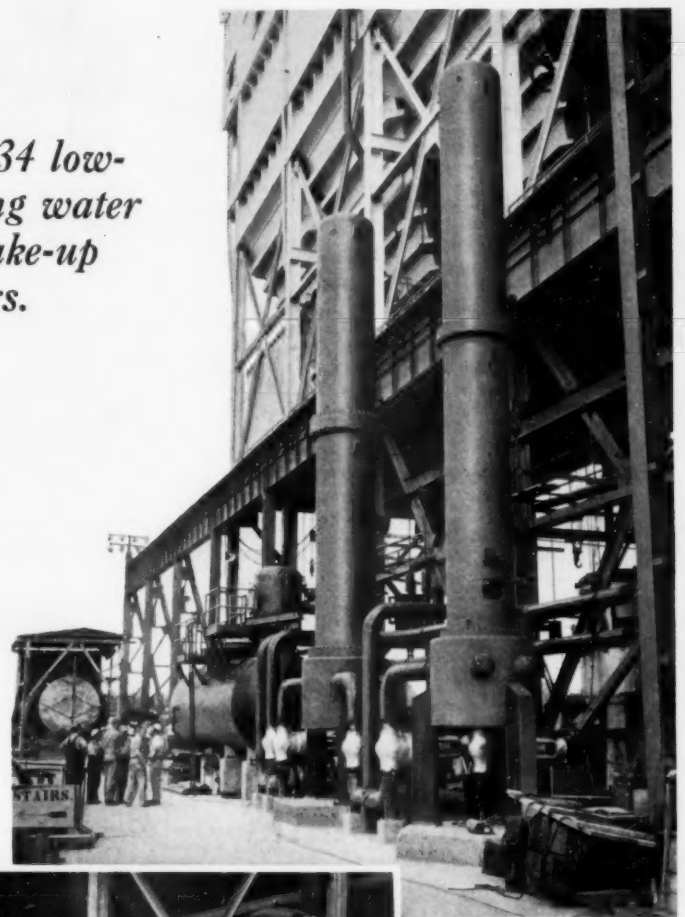
68 units to serve
JOPPA STEAM-ELECTRIC STATION

Feedwater installation by Foster Wheeler includes 12 high-pressure heaters, 34 low-pressure heaters, 18 cooling water exchangers (including make-up heaters) and 4 evaporators.

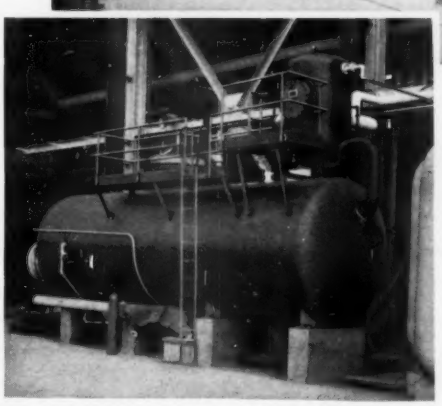
Constructed by Electric Energy, Inc. to supply approximately half of the power for AEC's Paducah Area Project, the Joppa Steam-Electric Station is designed for 937,500 KW in six boiler and turbine units. Of the semi-outdoor type, it represents one of the largest electric power stations ever planned for one building operation.

Few installations require the number of heaters which this new station will have when completed; probably none can boast of larger high-pressure heaters. The six crossover high-pressure heaters each have a surface of 7,760 sq ft capable of heating 1,162,700 lb of feedwater per hr from 411.1 F to 470.4 when supplied with steam at a pressure of 497 psia, total temperature of 721.1 F. The six 10th-stage high-pressure heaters each have 4,858 sq ft surface. Each set is equipped with desuperheating, condensing and drain-cooling sections, and is built for handling 3200 psi, 500 F water.

The closure for these high-pressure heaters incorporates the well-known "Lockhead" feature. A patented Foster Wheeler construction, this closure provides a means for supporting the head pressure load that is separate from that for supporting the gasket compression load. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.



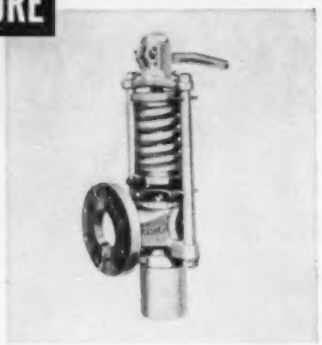
▲ Crossover and 10th-stage feedwater heaters. Crossover heater is approximately 38′ high. Shell design pressure is 550 psi at 800 F; tube design pressure 3200 psi at 500 F.

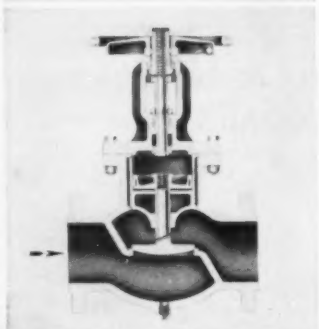


◀ Foster Wheeler evaporator with deaerating preheater. Total heating surface 3450 sq ft capable of evaporating 30,000 lbs net vapor per hr.

FOSTER WHEELER

for today's **HIGH PRESSURE HIGH TEMPERATURE** *steam stations*





• Foster Type 38-SV Super-Jet Safety Valves for steam pressures to 3000 P.S.I. and temperatures to 1100°F are designed for boiler drum and superheater outlets, reheater inlet and outlets, and, as a relief or safety valve on soot blower installations, turbines, pressure reducing valve and desuperheater stations.

Foster Super-Jet Safety Valves are protecting boilers at 2700 P.S.I. and 1100°F, and are also in service at pressures as low as 10 P.S.I.

Foster Super-Jet Safety Valves have been selected because of their high relieving capacity, adjustability for minimum blow-down, and consistent popping at name-plate pressure. The outside frame rod construction makes disassembly possible without disturbing spring setting, permitting inspection and relapping of seats during a minimum outage time. Piston freedom can be checked at any time with the valve under pressure.

• Foster Automatic Non-Return Valves Type 2C are available for 250 P.S.I. and 475°F; Type 2S for pressures to 900 P.S.I. and temperatures to 900°F.

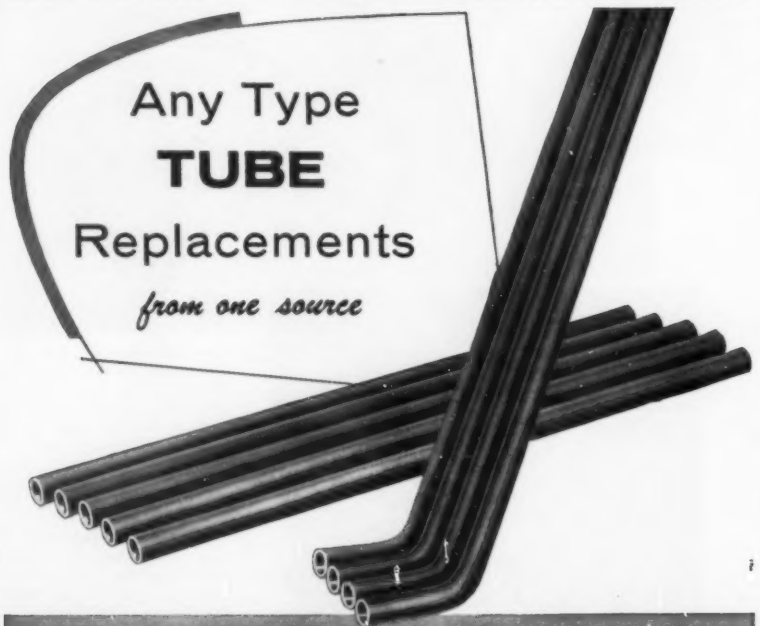
Designed to prevent a backflow of steam to a disabled boiler, piston assembly assures positive factor of safety. Main valve and seat rings are designed to permit full free flow of steam when the valve is in operation.

Foster Non-Return Valves have been in service since 1900 and today are installed in major steam plants throughout the country.

FOSTER ENGINEERING COMPANY
835 LEHIGH AVE. UNION, N. J.

AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

Any Type **TUBE** Replacements *from one source*



BOILER TUBE CO. OF AMERICA
McKEES ROCKS, PA.
(Pittsburgh District)
PITTSBURGH • CHICAGO • FRED S. RENAULD & CO., LOS ANGELES

More EQUIPMENT NEWS

Begins on page 166

stroke until positive snap-action occurs in either direction, according to manufacturer. Contacts handle 5 amps, 28 volts dc inductive; 10 amps, 115 volts dc non-inductive; 60 to 400 cycles. Unit mounts on 1½x1¼-in. panel area.

Guardian Electric Manufacturing Co, 1621-E W Walnut St, Chicago 12, Ill.

Two-Circuit Limit Switch

626 • Heavy-duty, two-circuit limit switch combines precision switching with rugged construction. Use of snap-action spring accomplishes simultaneous make and break of both contacts. Contact arrangement is single-pole, double-throw, two-circuit double-break. Switch is electrically rated for 10 amps, 125 or 250 volts ac and 10 amps, 30 volts dc, inductive. Switch measures ½x½x1¼-in.

Micro Switch, Div of Minneapolis-Honeywell Regulator Co, Freeport, Ill.

For more data on these items, use post cards p 175. Identify your request with item number.

Receptacle Device

656 • Raised adapter cover, designed to accept *Ever-Lok* receptacle without installation of separate boxes, snaps on duct raceway like standard capping, permits installation of receptacle device within body of duct. Although designed specifically for 20-a *R & S Ever-Lok* receptacle, new cover will accommodate various other large-bodied devices. Unit assures secure locking of male tap to receptacle and prevents accidental disconnection of power lines. A twist of the male cap quickly disengages it.

National Electric Products Corp, Pittsburgh, Pa.

(*Continued on page* 202)

WORLD'S FASTEST-GROWING CITY INCREASES POWER OUTPUT BY 160,000 KW.

PIRATININGA PLANT—SAO PAULO, BRAZIL
SAO PAULO LIGHT & POWER COMPANY, LIMITED
DESIGNED BY THE STONE & WEBSTER ENGINEERING CORP.

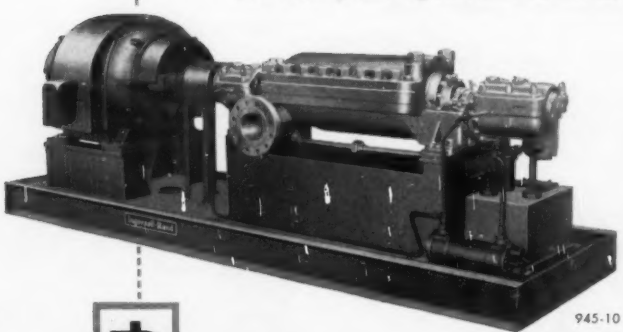
New São Paulo Steam Plant features ultra-modern equipment throughout... including six Ingersoll-Rand boiler feed pumps

Latin America's biggest industrial community eagerly awaits completion of the new Piratininga Plant of the Sao Paulo Light and Power Company, Ltd., subsidiary of Brazilian Traction, Light and Power Company, Ltd. This 160,000 kw steam plant, under construction on the outskirts of Sao Paulo, will increase the Sao Paulo Company's present capacity by over 25%—promising substantial relief for an acute power shortage in the fast-growing Sao Paulo-Santos area.

The new station, designed by Stone and Webster Engineering Corp. and built by Stone and Webster Construction Co., will include three, 8-stage Ingersoll-Rand Class HMTA boiler feed pumps for each 80,000 kw generating unit. Each pump is rated at 1142 gpm, 371° F and 1190 psi. The HMTA design, featuring the modern Unit-Type rotor assembly, assures sustained high efficiency, trouble-free performance and exceptional ease of maintenance.

In addition to the boiler feed pumps, the Piratininga Plant will use seventeen other I-R pumps for miscellaneous services.

Whatever your pumping requirements, Ingersoll-Rand can supply the right unit for the job. Your nearest Ingersoll-Rand representative will be glad to give you prompt, intelligent assistance with your selection.



945-10

Ingersoll-Rand

Cameron Pump Division
11 Broadway, New York 4, N. Y.

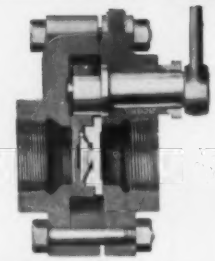
ROCK DRILLS • COMPRESSORS • AIR & ELECTRIC TOOLS • VACUUM EQUIPMENT • PUMPS • GAS & DIESEL ENGINES

EVERLASTING VALVES

Mean "Everlasting" Protection on these duties

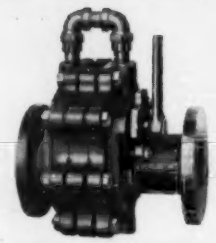
BOILER BLOW-OFF

Quick-opening, also hand-wheel operated. Angle and "Y" types and combination units meeting ASME Code requirements for pressures up to 600 psi.



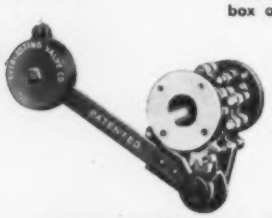
GENERAL SERVICE

Wherever frequent use and quick operation is required for any liquid or gas at pressures up to 300 psi. These valves have outside stuffing box and gland.



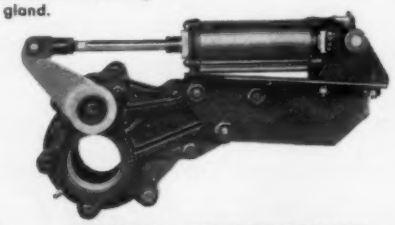
STEAM JACKETED

Assure continued free flow of any material which congeals at ordinary temperatures.



EMERGENCY PROTECTION

Closing type for inflammable liquid emergency shut-off, or opening type for deluge or drainage, assuring immediate and positive action with weighted pendulum stop.



CYLINDER-OPERATED VALVE

for accurate control of process work. Straight-through flow, drop-tight seal, air or hydraulic control for operation at any speed.

EVERLASTING FEATURES

For more than 40 years, EVERLASTING VALVES have been known for their ingenious design, simple, sturdy construction, and long trouble-free life with low maintenance expense. Some of their distinctive features are:

Quick-Action . . . Opened or closed with less than a quarter turn of the operating lever.

Straight-Through Flow . . . the disc cannot become loose and accidentally check the flow.

Drop-Tight Seal . . . constant contact of disc and seat at all times prevents dirt or scale from getting between.

Self Regrinding . . . the disc rotates on the seat with each operation, thus regrinding the sealing surfaces.

No Wedge Action . . . all parts move between parallel faces.

Write for bulletin describing* EVERLASTING VALVES *in detail.

EVERLASTING VALVE COMPANY 45 Fisk Street, Jersey City 5, N. J.

Everlasting Valves

TRADE MARK "EVERLASTING" REG U S PAT OFF

EV-381

for everlasting protection

More EQUIPMENT NEWS

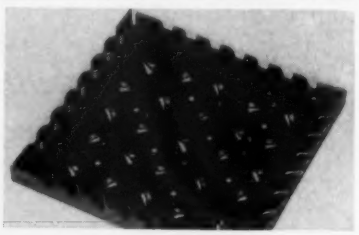
Begins on page 166

Industrial Roofing

657 • New lightweight corrugated aluminum sheet answers growing demand for maintenance-free roofing material of thinner gauge. Made of same high-strength alloy as standard .032-in. material, new roofing and siding material is only .024 in. thick. This light weight material will fill the need where narrow spans in roof support structure do not require extra-high beam strength. Full information on design loads, weight, coverage, etc. available on request to manufacturer.

Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa.

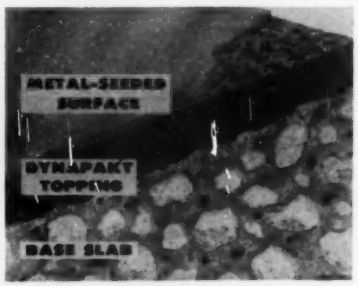
For more data on these items, use post cards p 175. Identify your request with item number.



Industrial Flooring

658 • New industrial floor, *Ancor*, consists of heavy-gauge rolled-steel plates that provide a hard abrasion-resistant surface. Each plate, embedded in concrete, is held firmly in place with 25 surface anchors and 28 edge anchors in each sq ft to prevent movement in either vertical or horizontal direction. Full details available on request.

Flash-Stone Co, Inc, 3723 Pulaski Ave, Philadelphia 40, Pa.



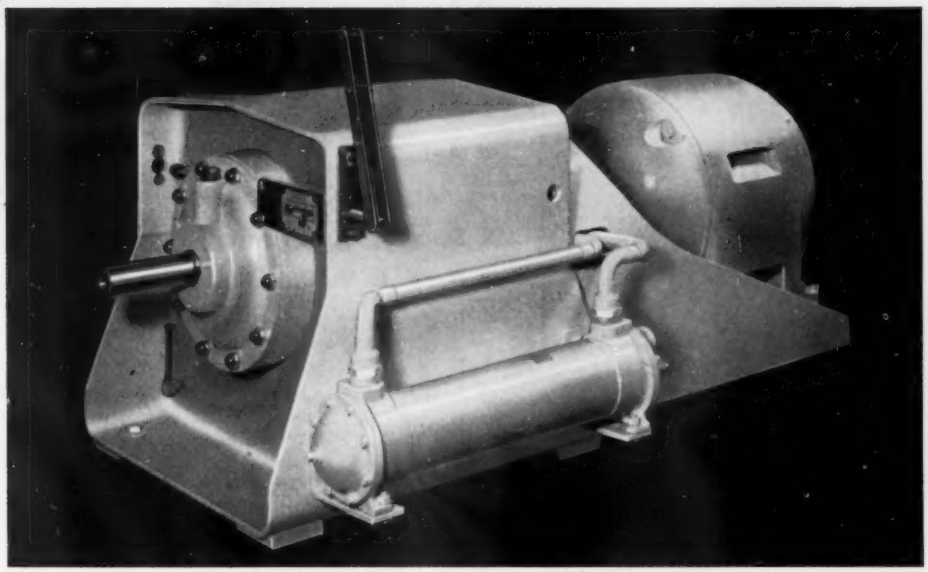
Flooring Process

659 • New industrial flooring process is said to add strength of iron to heavily-traveled concrete floors. Metal-seeded *Dynapakt* process installs 8-in. veneer of

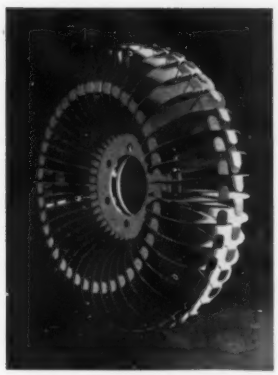
ANNOUNCING THE NEW AMERICAN BLOWER

Gýrol FLUID DRIVE

TYPE VS CLASS 2



American Blower Type VS Class 2 Gýrol Fluid Drive



A phantom view of the driving and driven members, which provide smooth, reversible power transmission.

- **Can be reversed while in motion at any variable operating speed by merely reversing direction of rotation of motor**
- **Permits adjustable speed control over a wide range**
- **Built in several standard arrangements**

HERE IT IS! A brand-new fluid drive that will help you solve many tough industrial-drive problems. It's the American Blower Type VS Class 2 Gýrol Fluid Drive. A compact, self-contained, adjustable speed unit.

The result of years of development and research, this adjustable-speed fluid coupling is crammed with features. It has unlimited application possibilities, with its wide-range, stepless speed, reversible control. Even on constant-torque loads, a 4-to-1 speed range is obtainable!

It permits driving motors to reach full-load speed before engaging the load. In many cases simple across-the-line starting may be used. Adjustable speed may be obtained by either automatic or manual adjustment of the speed-control lever.

The new Type VS Class 2 Gýrol Fluid Drive is available in six sizes . . . 7½ through 800 h.p., at normal motor speeds up to 1800 r.p.m. Built in five standard arrangements, it can be used on a wide variety of industrial applications.

For complete information about the Class 2 Gýrol Fluid Drive, give your nearest American Blower Branch Office a call, or write us for Bulletin 9419.

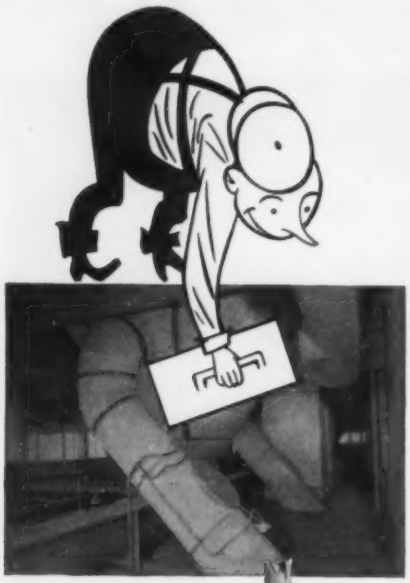
For smaller applications the Type TM Constant Speed Gýrol Fluid Drive is available in ratings from 1 to 20 h.p.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Save With This Matchless
ONE-COAT SUPER FINISH
Cement . . .
A Light, Efficient Insulation



- *Easiest to Apply*
- *Adhesive*
- *Maximum Coverage*
- *Smooth, White Finish*
- *Hard* ● *No Cracking*
- *Resistant to Abrasion and Water*
- *Ready to Paint or Weathercoat*

Use One-Coat Super Finish Stic-Tite on flanges, valves, fittings, flat or curved surfaces of boilers, fans, tanks and other equipment, whether indoors or exposed to the elements.

Save with R & I Super Finish Stic-Tite—the insulating cement that goes further—lasts longer. 100 lbs. covers 80 sq. ft.—½" thick, or 160 sq. ft.—¼" thick. Can be easily troweled smooth in ONE COAT directly on block, blankets or metal surfaces, air-drying quickly without shrinkage or cracking.

One-coat application saves time and labor.

Super Finish Stic-Tite is low in material cost, low in overall cost, long lasting.

R&I

SUPER FINISH STIC-TITE
Get the Facts — Mail this Coupon Today

REFRACTORY & INSULATION CORP.
132 WALL STREET • NEW YORK 5, N.Y.

Send me a sample bag of Super Finish Stic-Tite and bulletin

Name_____ Title_____

Company_____

Address_____

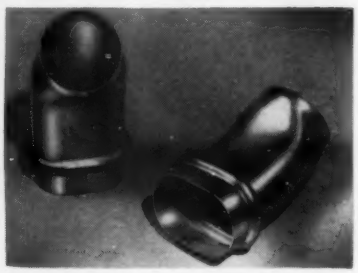
City_____ Zone_____ State_____

More EQUIPMENT NEWS

Begins on page 166

iron-chip aggregate as a non-spalling, non-crumbling, non-slip armor over fresh concrete topping. Special heavy duty power equipment does entire job to insure maximum compaction and adhesion of concrete and metal. Complete information, including survey of particular needs, available.

Flash-Stone Co, Inc, 3723 Pulaski Ave, Philadelphia 44, Pa.

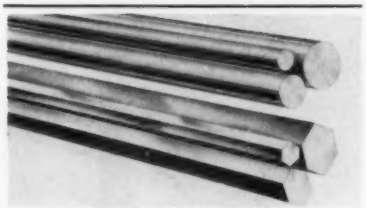


Stainless Steel Tubing

660 • New high-strength thin-wall stainless tubing has been developed for industrial uses where corrosion-resistance, light weight and special shapes or bends are required. In addition, company states it will fabricate special tubes in combination with fittings and its own flexible tubing or expansion joints. Standard straight-wall tube is available in 15 OD's ranging from 1 to 6 in. High-strength tube comes in 13 OD's from 1½ to 6 in. All but the smaller sizes are available in four wall thicknesses.

Flexonics Corp, 1301 S 3rd Ave, Maywood, Illinois

For more data on these items, use post cards p 175. Identify your request with item number.



Leaded Steel Bar

661 • *Super LA-LED,* a free-machining leaded steel bar is now available in wide range of sizes. Containing about ¼% lead and nearly ½% sulphur, it is recommended for applications where full advantage can be taken of its superior cutting speed.

LaSalle Steel Co, PO Box 6800-A, Chicago, Illinois

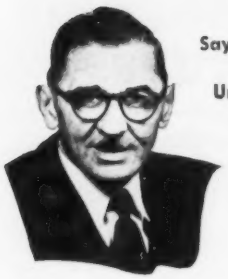
Stainless Steel Powder

662 • *Stain-Alloy,* new type of metal powder, consists of 18-8 low carbon moldable stainless steel. Material's inherent advantages are: increased resistance to intergranular corrosion of sintered compact, freedom from surface oxidation, moldability at 30 to 50 tons psi and effective sintering at 2100 F with normal time.

Alloy Metal Powders, Inc, 238 Eagle St, Brooklyn 22, New York

(More Equipment News on page 266)

"How modern coal equipment saves us $9,000 a year and solves our smoke problem!"



Says Albert E. Unruh,
Chief Engineer
University of Detroit
Detroit, Michigan

This is a smokestack. This beautiful War Memorial Tower actually conceals the smokestack for the U. of Detroit's steam plant. Though it's in the very center of the campus, there's never any smoke problem, thanks to a modern coal-fired power plant.

"Again and again over the last decade, coal burned with modern equipment has proved itself the most flexible, economical fuel for heating our school buildings. We made our first investment in modern coal equipment shortly after the last war. By 'restokering' two existing boilers, we saved $9,000 the first year—actually $2,500 more than we estimated. At the same time, we solved a disturbing smoke and flyash problem and provided enough steam capacity to heat additional new buildings.

"We're completely sold on coal. And when our building expansion program required us to further increase steam production, we again chose a modern coal-fired boiler. Coal has proved its ability to handle increased loads and save us dollars year after year. And modern equipment eliminates smoke nuisance."

Additional case histories, showing how other types of plants have saved money by burning coal with modern equipment, are available upon request.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for *hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

If you want to cut steam costs, it will pay you to investigate the advantages of modern coal equipment. For example, you may be able to save as much as 20% on fuel alone by replacing outdated equipment with modern stokers and boilers. Or, a small investment in modern controls and other up-to-date, fuel-conserving devices may boost efficiency of your present operation.

You can save on labor, too, by installing modern handling equipment. Modern coal-feeding and ash-removal systems can eliminate practically all hand labor.

Call in a consulting engineer. He can give advice on what equipment best fills your specific needs. And his recommendations may save you dollars year after year.

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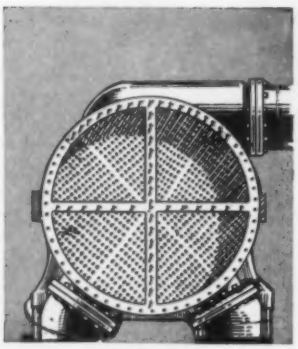
SAVE STEAM



by keeping condensers Oakite-clean!

BTU's fly up the stack when sludge and hard-water scale bog down condensers.

Here's how to stop this waste. Try Oakite's proved method of maintaining condensers. Powerful Oakite alkaline cleaner removes sludge . . . then use Oakite Compound No. 32 to dissolve lime scale—fast. Job is done in place, by circulating or soaking. No time-wasting dismantling of equipment.

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More TECHNICAL BRIEFS

Begins on page 162

executives, operators and maintenance men were queried on piping maintenance practices. The results are intended to appraise the level of maintenance in some plants. They do not show how the average plant handles its maintenance because the number of plants considered is not representative of industry as a whole.

Survey statistics show that 35% of the plants have some sort of an organized piping maintenance policy. Remaining 65% have no maintenance policy, except to make repairs when necessary. It is in these plants that the need for great improvement exists.

Questions asked in the survey included the degree of responsibility in piping maintenance, types of records kept, procedure for repair of leaks, types of piping used, when maintenance is done, reports to management, etc.

The three most important factors in expenses are wrong selection, dirt and foreign matter and lack of maintenance. Effectiveness of a maintenance program can be judged only in relation to the physical conditions and management policies in the particular plant. Experience is an excellent guide to the level of maintenance required. *APC paper.*

Water Treatment

Water Problems in the Nuclear Power Field. *By R C Ulmer, Nuclear Power Div, Combustion Engineering, Inc.*

Water problems in the nuclear power field are complicated by the fact that radiation present is hazardous and causes decomposition of the water itself and of materials normally used in its treatment. Further difficulties arise from the high radioactivity of nuclear and fission products. This activity persists for many years.

Many products are also toxic. These immediately present radiation and toxicity problems, in addition to problems of safe and permanent disposal.

Decomposition of water and aqueous solutions by radiation results in the formation of hydrogen, oxygen and hydrogen peroxide. Other products may form, depending on the solutes present.

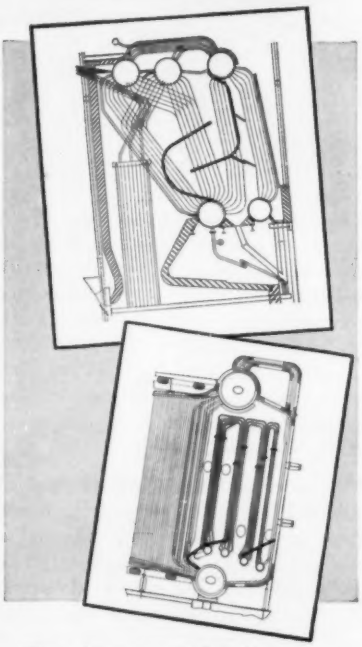
Essentially, the action of radiation is one of ionization. Back reactions occur, resulting in establishment of a steady-state level of activity.

Investigations are now under way to find solutions to the major water problems in nuclear power. These involve corrosion, types of materials, water and steam purity, monitoring or testing of water for radioactivity, permanent dis-

Directions for ordering papers on p 164

ONLY ENCO BAFFLES

give you all these **COST CUTTING FEATURES**



These important fuel-saving maintenance-reducing features are obtainable with Enco boiler baffles—*and only with Enco baffles.*

- **Streamlined gas flow**
- **Uniform gas flow**
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- **Reduced draft losses**
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Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.

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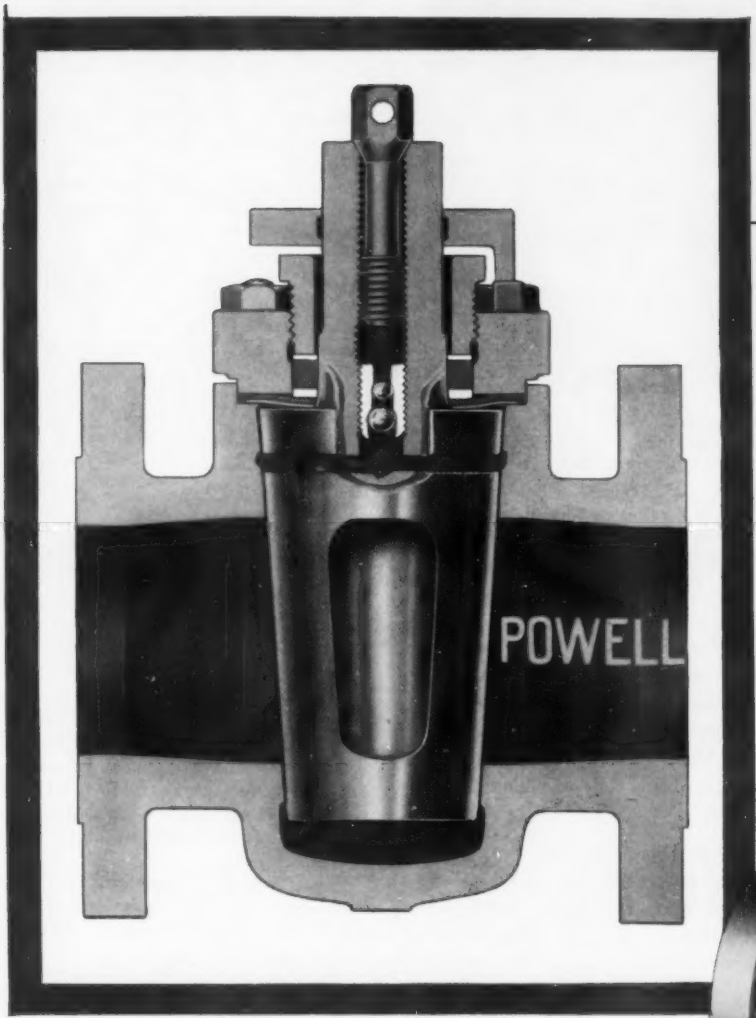
Now! A great new line of valves that maintain the Powell standards of precision!



Investigate these outstanding new Lubricated Plug Valves that carry the Powell name and measure up to the Powell standards of precision. Features include quick and positive operation – just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

Available in Semi-Steel and Carbon Steel through distributors in principal cities. For descriptive literature–or help on valve problems–write direct to The Wm. Powell Company, Cincinnati 22, O.

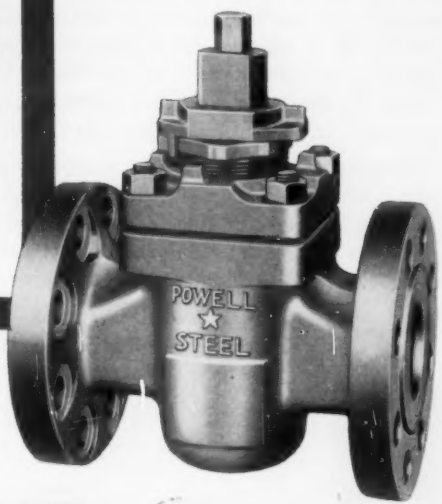


FIG. 1559 — 150-POUND STEEL FLANGED END LUBRICATED PLUG VALVE. *(300-pound Steel, Fig. 3059.)* Available with Screwed or Bolted Glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.

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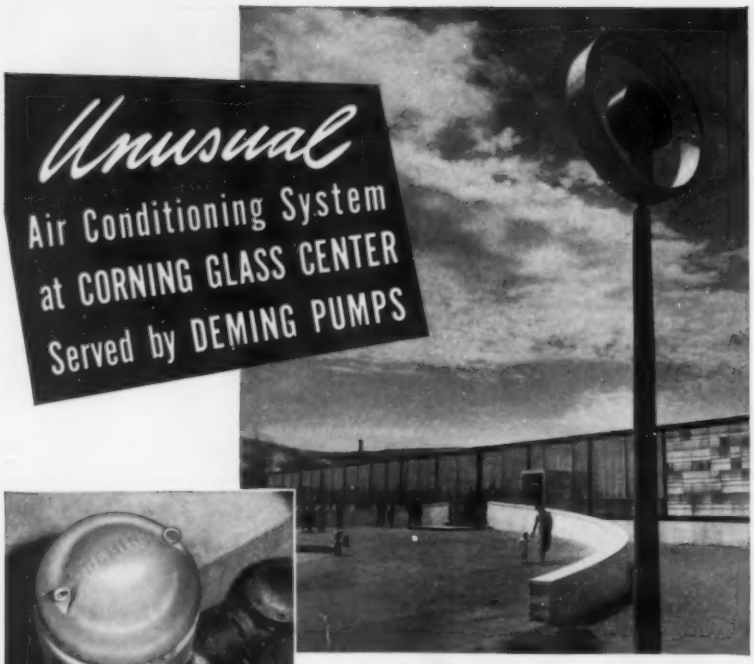
Powell Valves *108th year*



Unusual
Air Conditioning System
at CORNING GLASS CENTER
Served by DEMING PUMPS

Above view shows main entrance of the Corning Glass Center, established in 1951 by the Corning Glass Works at Corning, N. Y.

View at left shows the Deming Vertical Turbine Pump which serves the versatile air conditioning system at the Corning Glass Center.

Dedicated to the history, art and science of glass-making, the Corning Glass Center at Corning, N. Y., has been visited by more than a million people since its official opening in 1951. Maintaining proper temperatures throughout its multiple units requires an extremely versatile and flexible system of air conditioning. Cooling loads are unusually high and variable due to the glass walls, absence of shade, and constantly changing numbers of people in the numerous units of the Center.

A Deming Vertical Turbine Pump supplies water from a 100-foot well to the condensers. A system of chilled water circulated to conditioning equipment for each area or group of areas is used. Loads total approximately 300 tons and require circulation of an aggregate of approximately 100,000 CFM of conditioned air.

For complete information about the applications of Deming Vertical Turbine Pumps in air conditioning systems and for many other uses, write for Bulletin 4700.

THE DEMING COMPANY
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Deming
VERTICAL TURBINE PUMPS

More TECHNICAL BRIEFS

Begins on page 162

posal of wastes, etc. *APC paper.*

Industrial Plant Waste Disposal Problems and Their Solution. *By John W Townsend, Consoer, Townsend & Associates.*

In recent years public health authorities and the general public have become more pollution conscious than perhaps at any other time in history. Alarming water shortages resulting, in part, from an ever-increasing demand on our supplies, have attracted public attention to water-conservation and waste-disposal problems.

Rapid industrial growth and increased population have taxed water-supply and sewage-treatment facilities to the limit in many areas. In some areas, raw sewage and untreated industrial wastes are discharged directly to a receiving stream because facilities are overloaded. The stream is both unhealthy and unsightly.

Estimates show that almost half the total pollutional load carried by water courses in the U. S. is caused by industry-discharged organic materials. Reducing waste volume by improving plant housekeeping and separating contaminated wastes from pollution-free waters can save on the investment for treatment facilities and on annual operating costs for treatment.

Important in the design of new plants is the location of various processes discharging waste water, method of conveying wastes to a central point for treatment, and location of treatment facilities with respect to process equipment. Existing industries facing waste-treatment problems require detailed studies to determine the most practical and economical method of collecting wastes and transporting them to a site for treatment.

Regulatory agency determines, for most plants, the treatment method required. No one treatment is suitable for all industrial wastes.

Where waste flow volumes are large, the installation cost of continuous-type treatment facilities is usually less than batch-type. Rectangular API separators are the most widely used today to remove free oil from water. Lagooning of sludge in large installations is not considered a satisfactory treatment. *ASLE paper.*

Evaluation of Several Alkaline Compounds for Controlling Corrosion-Erosion in Boiler Feedwater Systems. *By J M Decker, Senior Research Engineer and J C Marsh, Technical Engineer, The Detroit Edison Co.*

In the past few years there has been much interest in pH control with ammonia and with amines for inhibiting

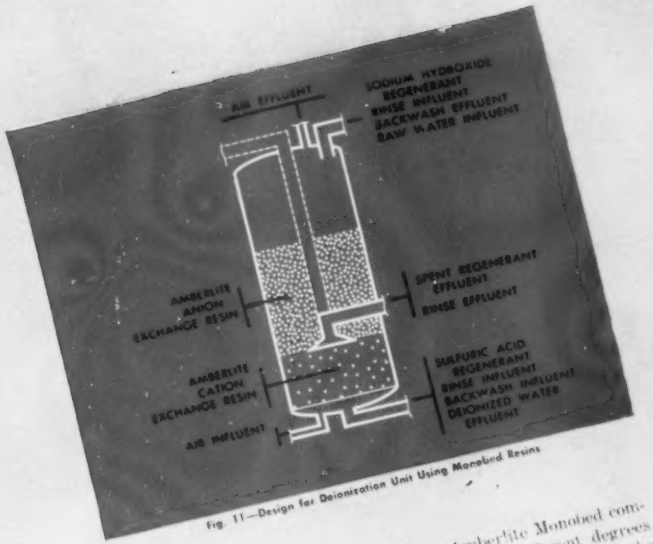

Fig. 11—Design for Deionization Unit Using Monobed Resins

...are, at present, several different Amberlite Monobed com-...ing various functions, yielding different degrees ...discussed briefly. The choice of the ...course, is best made after ...ively to the vari-...ion

Remove All Dissolved Minerals from Water Supplies... Including Silica...at Low Cost

Two major processes are available to you for removing dissolved minerals from your water supply. One system employs multiple beds of AMBERLITE ion exchange resins; the other, a single bed—MONOBED—of AMBERLITE exchangers. Either system may be varied in many ways to suit your needs. You can remove *all* dissolved minerals. You can get water with an electrical resistance of 50,000 ohms-centimeters or 5,000,000 ohms-centimeters.

Regardless of which system you choose, you can cut costs over older evaporative methods, save time, be assured of consistently high quality water.

New Book Discusses Treatment of Water by the AMBERLITE Ion Exchange Resins

If you use water, you will be interested in obtaining a copy of *If You Use Water*, a 24-page book on the treatment of water by AMBERLITE ion exchange resins. A request to Rohm & Haas Company will bring you this publication, which contains information not only on silica removal and deionization, but on softening, dealkalization, and many other aspects of water conditioning.

Write for your free copy of this book today

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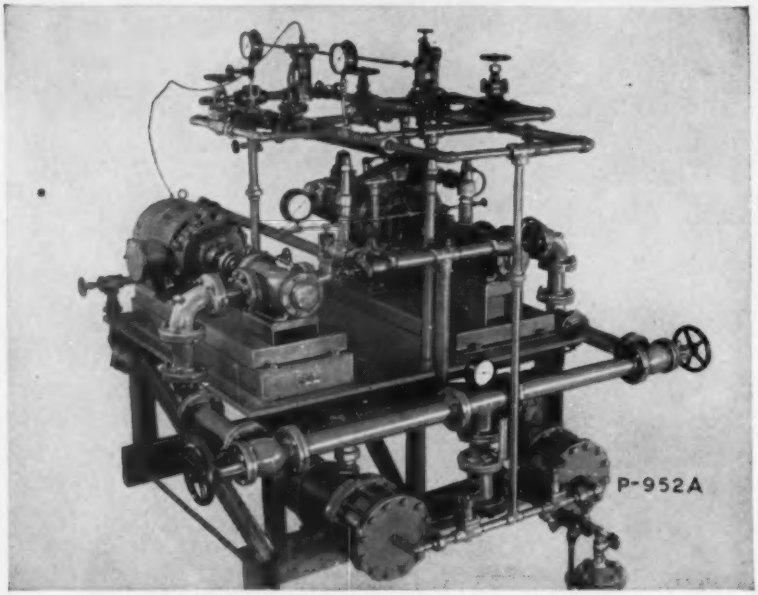

P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

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More TECHNICAL BRIEFS

Begins on page 162

corrosion in the steam-water systems of central power stations. Studies show iron corrosion is reduced by increasing feedwater pH to about 9. Copper alloy corrosion also appears to be less.

But none of these studies give any specific information on the effectiveness of the treatment in preventing wastage of ferrous and nonferrous materials subjected to erosive forces in pumps, regulating valves, sharp bends in feed lines, and other places where turbulent flow occurs. In these units, corrosion products that normally serve as protective coatings may be removed as rapidly as they form, allowing rapid metal wastage.

Volatile compounds are desirable for controlling feedwater pH because they do not accumulate in the boiler water. Ammonia, cyclohexylamine and morpholine are volatile and are currently used in a large number of power stations. These and sodium hydroxide (nonvolatile) were studied for their effects on a number of metals and alloys commonly used in steam-water systems.

Under the test conditions it was found that ammonia greatly reduces the rate of attack of ferrous metals but has little or no effect on nonferrous metals. Sodium hydroxide greatly reduces the attack on all metals tested. Cyclohexylamine has about the same effect as ammonia, while morpholine did not reduce the attack rate on any of the metals tested. *APC paper.*

Silica Removal by Salt Splitting Without Demineralizing. *By S B Applebaum, Mgr, Water Treatment Dept, Cochrane Corp, and B W Dickerson, Engrg Dept, Hercules Powder Co.*

Silica removal from boiler feedwater became necessary when pressures rose above 500 psig. At higher pressures, silica causes objectionable glassy deposits in steam turbines, and often plays a part in forming hard boiler scale. Deposits reduce turbine efficiency, leading to expensive outages for removal.

Only remedy proposed so far is reduction of silica in turbine steam to a low level. This requires maintenance of low silica concentrations in boiler water. Increased blowoff may be helpful but where makeup contains high amounts of silica, blowoff becomes excessive. Then treatment of the feed becomes essential to reduce silica.

Two methods of silica removal have gained general acceptance in the last few years: demineralization or deionization, and hot lime zeolite. The first removes silica and other dissolved solids, producing a water as low in electrolyte

(*Continued on page* 214)

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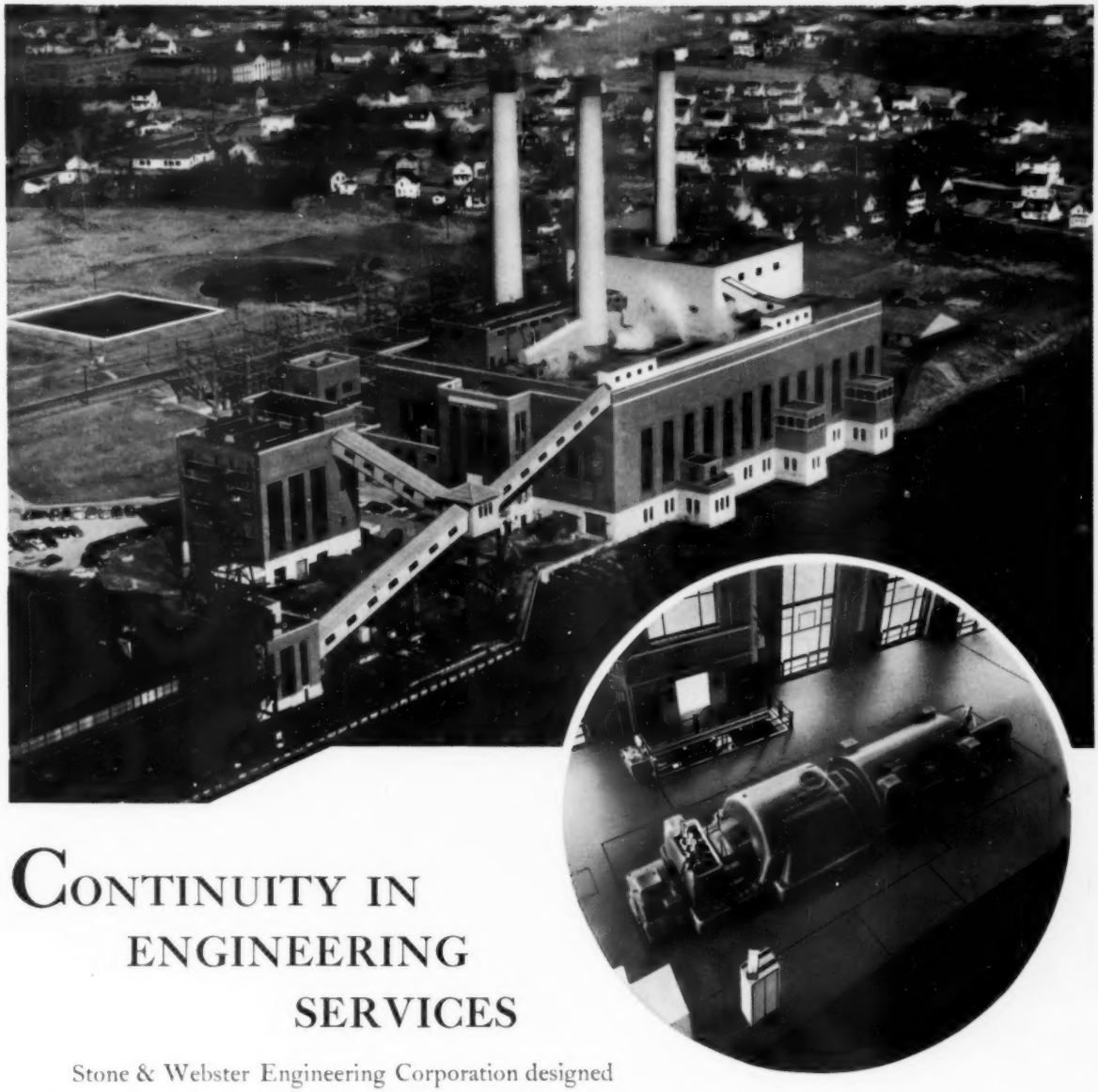

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Stone & Webster Engineering Corporation designed and constructed the first unit of Somerset Station for Montaup Electric Company at Somerset, Massachusetts in 1924. Three years later the Engineering Corporation designed and built a second unit; in 1942 the first large high pressure controlled circulation boiler in this country and a third unit were installed; in 1947 a fourth unit was added and a fifth unit is now on the line.

Four-fifths of all the construction work of the Corporation amounting to well in excess of three billion dollars has been in the form of "repeat orders" from clients.

With the fifth unit shown above, Somerset Station has a net capability of 240,000 kilowatts

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

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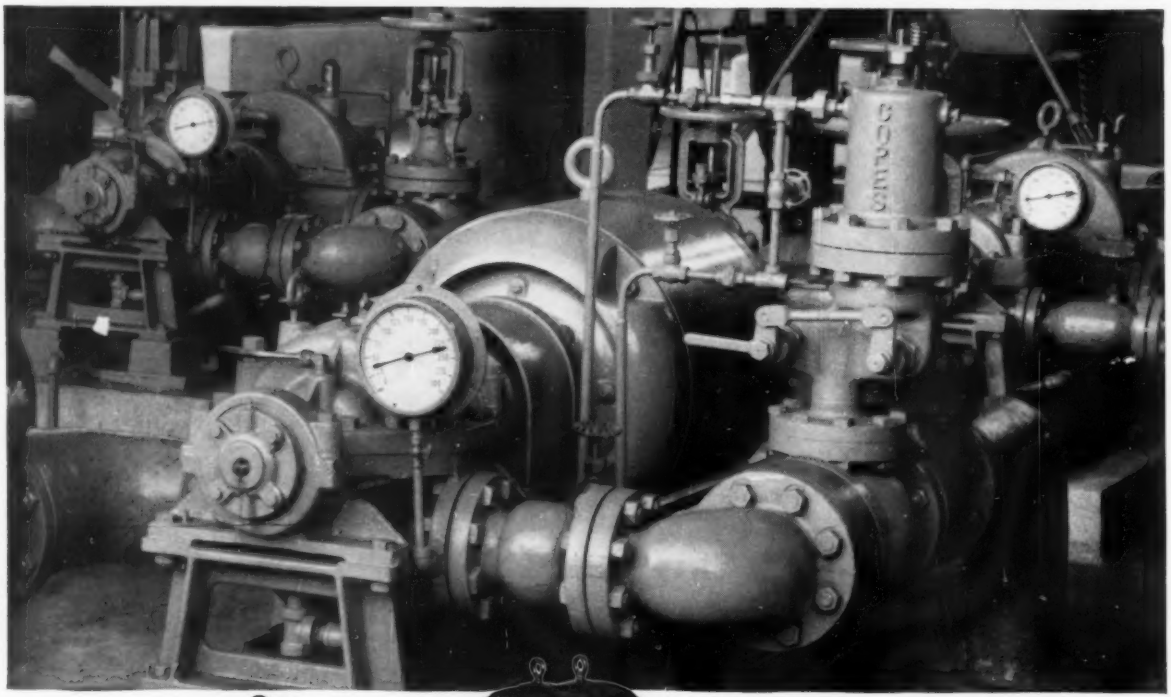
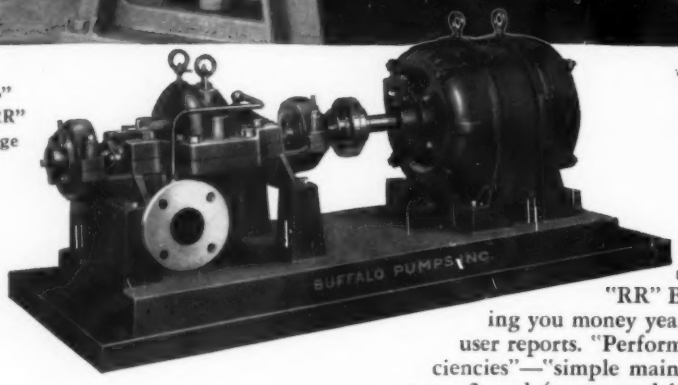


"Buffalo" Type "RR" Two Stage Pumps



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Not only moderate in first cost, but a real dollar-saver in maintenance, the rugged "RR" Boiler Feed Pump will keep right on saving you money year after year. We know this by the actual user reports. "Performance as rated"—"exceptionally high efficiencies"—"simple maintenance"—"long life" headline these reports. 2- and 4-stage models to handle your requirements. For heads clear up to 1500 ft. Engineering Bulletin 980-C shows how you can cut *your* power costs in the boiler feed department, with "Buffalo" Type "RR" Pumps! Write for your copy.

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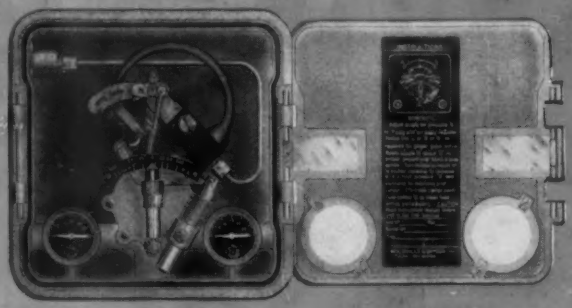
. . . An Even Better Pressure Controller — Climax Type 1440



The Climax Type 1440 Pressure Controller (non-recording) is designed to handle both positive and negative pressures, from high vacuum to pressures of up to 10,000 lbs. Bourdon Tube actuated — with all tubes, bellows assemblies, feed orifices and bleed nozzles calibrated — the Type 1440 is an instrument of utmost accuracy. Proportional band and On-Off or Maximum-Minimum snap action adjustment is easily made without additional parts. Snap action may be adjusted to pressures up to 75% of the limits of the Bourdon Tube rating.

. . . An Even Better Liquid Level Controller Pilot . . . Climax Type 1450

The type 1450 Liquid Level Controller Pilot was developed for use and mounting on any Climax Type 888, 888-LF, 887 and 889 displacement liquid level controllers where a torsion tube transmits float movements to reflect changes in liquid level or a change in gravity of the controlled liquid. Its interchangeability of parts with those of the Type 1440 Pressure Controller is an advantage which reduces stocking parts.

Type 1450 features a very wide "throttling" range calibrated from 0% to 100%. A specific gravity index is provided and offers a method of compensating for various gravities of liquids, or for inter-face services, where the "throttling" range is kept exact in its relationship to the specific gravity setting.

A novel feature of the Type 1450 is its adjustability, without use of special parts, for "snap" or "on-off" action. This is useful when it becomes desirable for the diaphragm control valve to fully open or close when liquid level height reaches a desired "high" setting, and to react in an opposite manner at a desired "low" setting. The amount of liquid level change from open to shut positions of the control valve may be varied up to 75% of displacement element length.

Improved Features of Types 1440 and 1450:

1. Weatherproof case of die-cast aluminum designed for universal mounting.
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More TECHNICAL BRIEFS

Begins on page 162

as distilled water. It is, therefore, being rapidly adopted in the public utility field in place of evaporators for installations where makeup is usually low and boiler pressure exceeds about 1000 psig. Hot lime zeolite is usually preferred for industrial plants with boiler pressures between 500 and 1000 psig because first and operating costs are lower.

This paper reports a search for a possible third method of silica removal—salt splitting. Results of a joint research project of the authors' companies are given. A typical case history for an industrial plant in Georgia is studied and the economics of salt splitting evaluated.

Results of the project show that silica removal by salt-splitting anion exchange is thoroughly practical. Its field of application will usually be for boiler pressures of 500 to 1000 psig and for raw waters high in silica, low in other dissolved solids. Operating cost will be lower than demineralizing but higher than hot lime zeolite. An economic study will have to be made before it can be determined if this third method is best for a given set of plant and water conditions. *APC paper.*

Internal-Combustion Engines

Toward a More Successful Operation of Diesel Generating Facilities. *By Robert J Daverman, Partner, James A DeWinter, Chief Electrical Engr, and Jack H Knol, Electrical Engineer, J & G Daverman Co.*

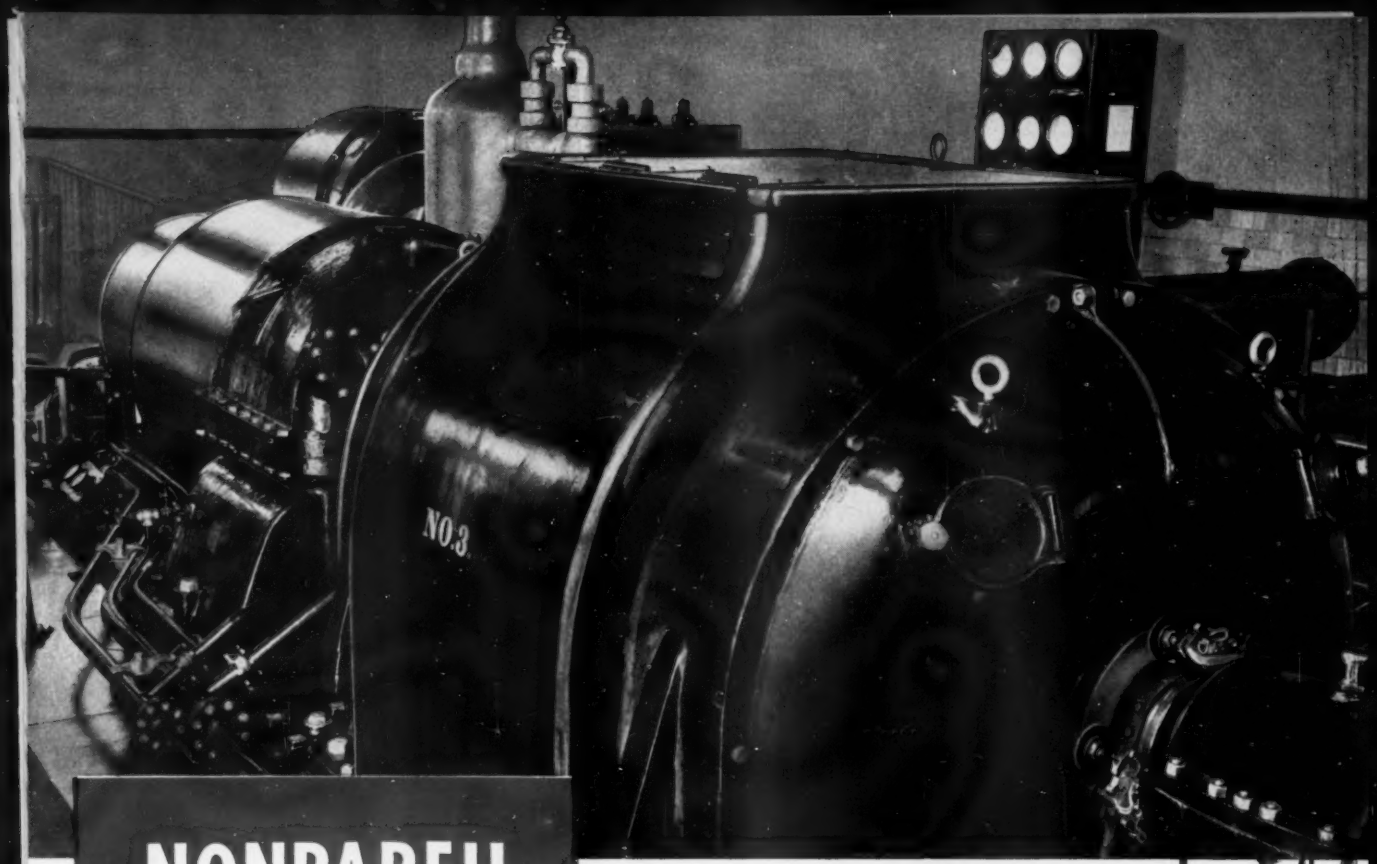
Today, with more competition, the long-range criterion for success of any power producing operation is its survival. Three factors important today are advances in materials and equipment, use of these advances in a well-designed generating plant, and efficient operation of the plant.

Planning to prevent operating and administration difficulties cannot be overemphasized. Load growth and operating costs require careful study at all times. Economic studies are the best answers to a number of common problems.

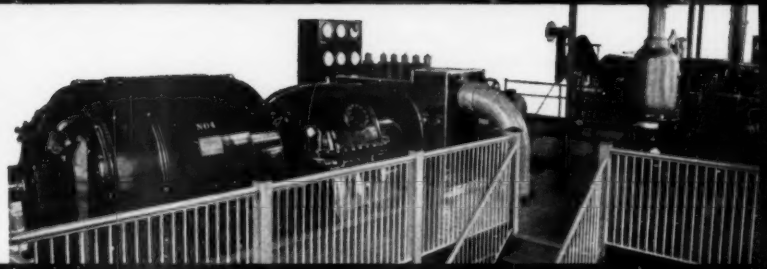
For maximum economy, diesel generators should be sized so they run most of the time at or near their economical loading point and so plant has sufficient capacity in excess of firm capacity to assure service continuity. However, capacity should not be so great that there are needless or premature fixed charges.

Units for only peaking service must furnish maximum capacity at minimum

Directions for ordering papers on p 164



NONPAREIL
TRADE MARK
Turbine Oil



How they eliminated turbine oil replacements

● Operators of this midwest power plant recall the time when a conventional lubricant was used in the plant's three turbines (now, four). A fill of oil was good for about three years and then it had to be replaced because of increased acidity and other indications of oil deterioration.

In 1939, a Standard Oil lubrication specialist recommended NONPAREIL Turbine Oil, and the switch was made. Since that time, none of the original fills of NONPAREIL has needed to be replaced. For that matter, no fill of oil has needed to be removed from its turbine for any purpose. Lubrication systems have remained clean. Neutralization numbers of oil fills have stayed below 0.06 mg. KOH/gm.

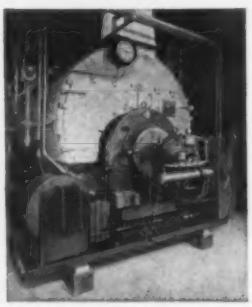
Fourteen years of trouble-free turbine lubrication is just the beginning for this plant. Each fill of NONPAREIL is guaranteed in writing to last as long as the turbine it lubricates and to maintain a neutralization number below 0.15 mg. KOH/gm.

Ask the Standard Oil lubrication specialist serving your area of the Midwest to show you how NONPAREIL and its written guarantee will assure you of completely trouble-free lubrication for the life of your turbines. Phone your local Standard Oil office. Or, write: Standard Oil Company, 910 So. Michigan Ave., Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD *(Indiana)*

Michigan Firm "Flies In" New RAY Forced Draft 'Packaged' Burner

DEARBORN, MICHIGAN—A new RAY forced draft "packaged" oil burner was installed in the new plant of Contract Specialties Company here after a flight from the West Coast via Flying Tiger, according to E. F. Freeman, mechanical engineer of the company.



Ray Engineering Company of Detroit, oil burner contractor on the Contract Specialties installation, reported combustion efficiency at 83.3% after special tests. Hurless E. Bankes was architect for the Contract Specialties building; Stanley Carter Co. was heating contractor. General contractor was H. E. Campbell Construction Company.

This Ray Size 5 FDAR-144 heavy oil burner unit was one of the first local applications of Ray Oil Burner Co.'s new "packaged" units, which are available with all combustion components necessary for fully automatic operation on oil, gas, or combination gas-oil, factory wired, piped, mounted on a structural steel base, ready for installation on the boiler front.

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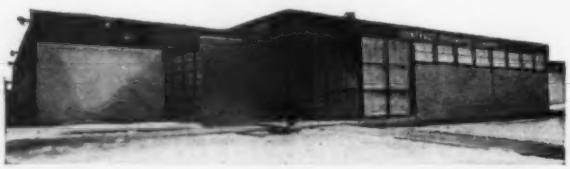

More TECHNICAL BRIEFS

Begins on page 162

investment. Efficiency, operating economy and maintenance are secondary. But for base-load duty, efficiency and economy of operation are of paramount importance.

Stability is another important consideration because operation at critical speed has caused several crankshaft failures in recent years.

Fuel economics in a given locality deserve periodic investigation. Low-cost heavy fuel can give substantial savings but it must be remembered that the cheapest oil is not always the most economical for every installation. Heavy oil requires special handling equipment costing $3 to $14 per kw, depending on number of factors.

Propane, butane and casing-head or natural gas are other fuels that can be exploited to reduce fuel costs. Cost of converting to dual-fuel including piping, regulators and meters varies, but in no case should conversion exceed $15 to $18 per kw. Ventilation is an important consideration in plants using gas for the first time.

Operation, maintenance, records, noise, vibration and fumes are other important factors requiring careful analysis for best output from an existing or planned installation. *APC paper.*

Factors Affecting Oil Drain Practices for Diesel Engines. *By Lewis F Moody, Jr, and John C Gibb, Staff Engineers, Lubricating Dept, Socony-Vacuum Oil Co, Inc.*

Determining and establishing right oil-change periods for diesel engines is of serious concern to operators, owners and engine builders. Oil kept too long in service causes a dirty engine, often accompanied by excessive wear or damage to parts from impaired lubrication. Unnecessarily frequent oil changes, on the other hand, are not only wasteful but costly.

It is important to understand that the best oil cannot overcome the detrimental effects of poor maintenance, poor operation and poor fuel. Careful control of these factors reduces the load on the oil and gives the operator the opportunity of longer drain periods consistent with longer engine life.

Since oil cost is a very minor percentage of total operating cost, the operator will, in general, benefit from the use of higher rather than lower quality oils. The paper presents methods and techniques for examination of used oil samples and discusses the significance of various oil inspection tests. *ASME paper No. 54-MEX-3.*

Directions for ordering papers on p 164

This Mead-Morrison Unloader is installed at the Indiana & Michigan Electric Company's new Tanners Creek Plant at Lawrenceburg, Indiana. It is regularly operating in free digging at a maximum capacity of over 700 tons of coal per hour from barge to hopper.

The machine excels in simplicity as well as in capacity. It provides an ease and smoothness of grab bucket control . . . both in free digging and in barge clean-up operations . . . never before obtainable in a machine operating on alternating current.

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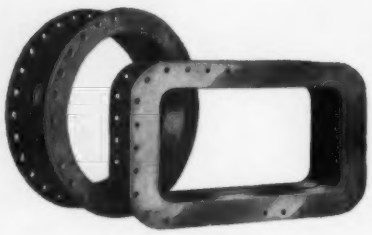
Garlock Rubber Expansion Joint on vacuum line between turbine and condenser

Expansion joints in operation on 2½" suction and discharge pipes

Sectional view shows sturdy construction of single arch joint. Arrow points to one of steel reinforcing rings

GARLOCK
RUBBER
EXPANSION JOINTS



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More PLANT PROBLEMS

Begins on page 142

Accumulators

Continued from page 144

passes through valve *B* into line *A* where it closes nonreturn valve *E*. Then it enters line *D*, passes through nonreturn valve *F* to enter charging manifold *G* to which nozzles *H* are attached.

As shown in the detail drawing, the steam discharges upward inside convection pipe *K*, drawing water into the pipe. Circulation of the water is rapid and noise-free, with quick condensation of steam entering the accumulator.

Accumulator pressure and water temperature rise during the charging period. Rise in water temperature permits more steam to condense; this in turn allows more heat to be stored.

When process loads require steam, control valve *C* opens, the pressure in line *A* falls, and nonreturn valve *E* opens while nonreturn valve *F* closes. Pressure in the process lines is less than in the accumulator and the stored water flashes into steam. Nozzle *L* prevents the steam from discharging at too high a velocity, a condition that might result in priming or carryover.

Many control arrangements are possible for an accumulator. Exact hookup selected depends on process needs, relation between boiler and process pressures, accumulator size, and a number of other factors.

EDGAR E MOSS *New York, N. Y.*

FIRST STEP in finding if an accumulator is suitable is to measure the actual steam load in the plant. Use a recording steam flowmeter with pens for both flow rate and pressure variation. Knowing flow required and the variation in line pressure permits more accurate sizing of the accumulator.

FG should not try to estimate steam load by working back from plant fuel consumption and steam ratings of process equipment. The results are seldom satisfactory.

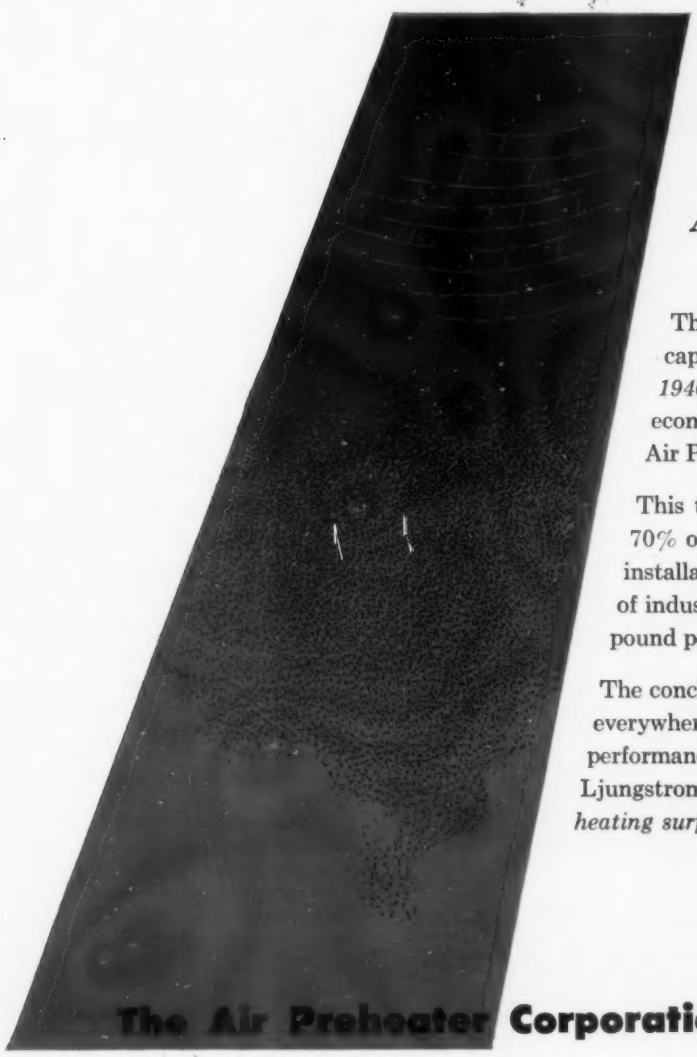
With the flowmeter readings available, it is relatively easy to estimate average and peak steam loads that must be met. Using these loads, the most economical accumulator can be chosen. Often, the accumulator will have to carry more than one load peak. The flowmeter shows these peaks and the time between them.

Quantity of water that must be stored can be determined from the properties of steam and water. Vessel size is found by allowing about 90% of its volume for water, 10% for steam.

H S EVANS, JR *Wichita, Kan.*

(*Continued on page* 220)

420,000,000 pounds of steam per hour



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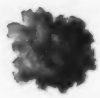

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Our informative brochure—The Collection and Recovery of Industrial Dust—explains *all three* Buell systems for industrial dust collection. For your complimentary copy write Dept. 50-F, Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

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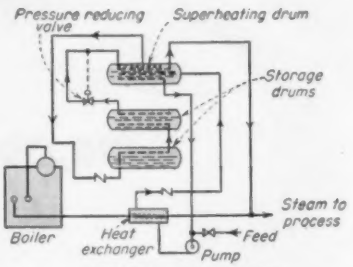
More PLANT PROBLEMS

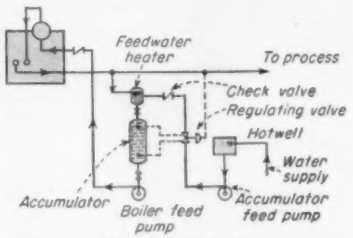
Begins on page 142

Accumulators

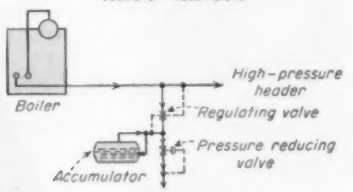
Continued from page 218



High-Pressure Accumulator



Feedwater Accumulator



Low-Pressure Accumulator

USE HIGH-PRESSURE accumulator for loads with few and irregular extreme peaks. A low-pressure unit is better for sudden, short load fluctuations. To increase boiler steam output a feedwater accumulator is usually best.

High-pressure accumulator is designed to meet a peak load instantly and carry it long enough to allow boiler rating to be increased. As sketch shows, this accumulator consists of a series of storage drums, the first of which has its feed heated by a special heat exchanger. To supply heat needed for peak loads, it is usually necessary to add more superheating surface to the boiler. If the main boiler cannot supply enough superheated steam to charge the accumulator between peaks, a small high-pressure boiler may be used for this purpose.

Low-pressure accumulator is filled with water to about 95% of its capacity. Live steam enters through charging nozzles below the water level in the drum. When completely charged, the accumulator contains saturated water at the maximum operating pressure used in the process system. Sketch shows a typical hookup for this type of unit.

Feedwater accumulator permits oper-

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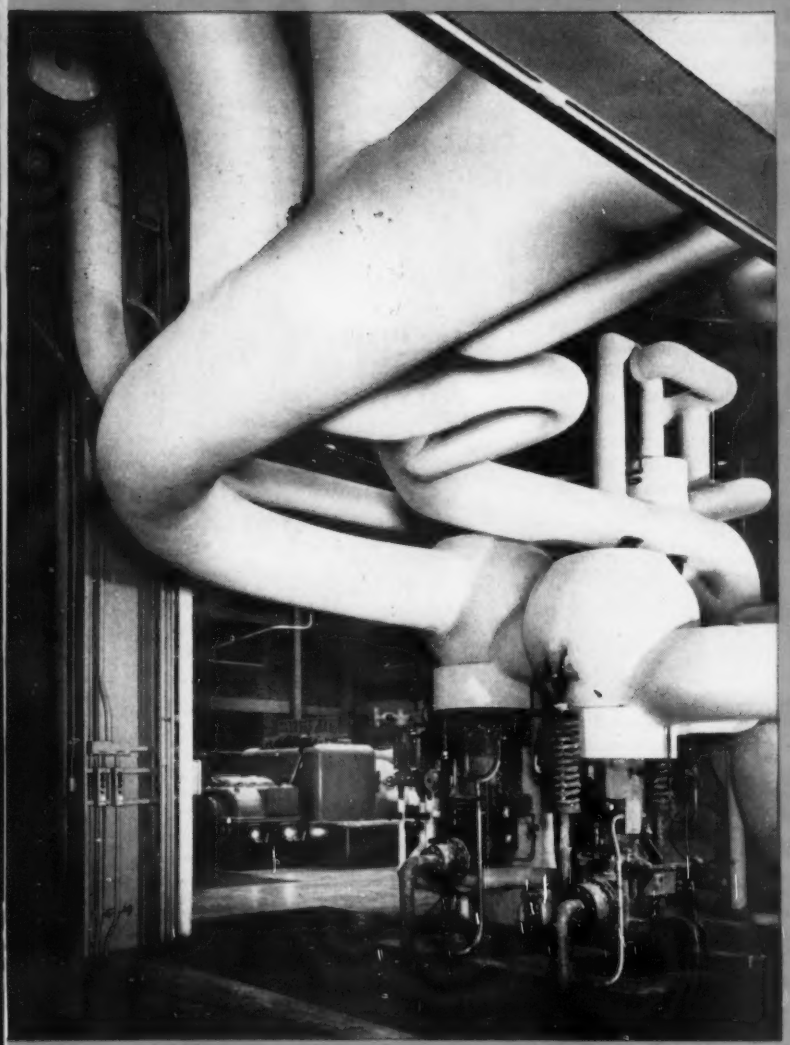

What you really buy is performance . . . and good value for your piping dollar. And how do you get these? By selecting a piping contractor who has a reputation for quality work . . . who is called upon to do job-after-job for the same customers. It's as simple as that.

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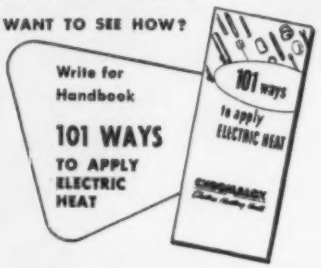

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More PLANT PROBLEMS

Begins on page 142

Accumulators

Continued from page 220

ating the boiler at steady firing rates and increases the steaming capacity by furnishing feedwater at about saturation temperature. In effect, the accumulator functions like an economizer, preheating the feedwater. But it also provides heat storage when process demand falls off.

As sketch shows, this hookup includes a direct-contact feed heater, accumulator, feed pump and water-regulating valve. Boiler steam is used in the direct-contact heater.

WILLIAM J BURNS *Westbury, N. Y.*

WHICH IS MORE ECONOMICAL? Installing an accumulator or more boiler capacity? This is the question *FG* must answer before he chooses an accumulator over greater installed steam-generating capacity.

FG will find that large high-pressure accumulators are likely to be costly. On the other hand, it may be impossible to install an additional boiler in his present plant, or the large load fluctuations may lead to excessive boiler and firing-equipment maintenance. However, many textile mills successfully use accumulators today to smooth peak loads. From the results of their experience it seems *FG* is on the right track.

ALBERT MOULTON *Pittsfield, Mass.*

ENGAGE a consulting engineer to advise on accumulator size, capacity, hookup and location. Then *FG* will be certain to get satisfactory results from his installation. Though some plants use old boilers as accumulators, their safety is questionable unless local authorities inspect and approve the vessels.

ART BELTON *Montreal, Canada*

Other readers sent good answers to this question. Sorry we didn't have enough space for letters from:

JOHN B THUMAN *Buffalo, N. Y.*
A A HUNNEWINKEL *Woodstock, Ill.*
ORVILLE JACKSON *Alton, Ill.*
J AIKMAN *Drummondville, Can.*
IRA A BUTCHER *Cincinnati, O.*
G HOWARD *New York, N. Y.*
A B LEBLANC *Quebec, Can.*

Grounding neutrals

Continued from page 146

tral systems. Line-to-ground faults lead to insulation failures, equipment damage and service interruptions.

Use solid neutral grounding on all systems rated 600 v and under. Resistance grounding is generally used with 2.4- to 13.8-kv systems, while solid

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For full details about the money-saving, maintenance-free advantages of these "features", plus valve data and specifications, write for your free copy of this new UNI-LINE 41-W-200 Series Bulletin.

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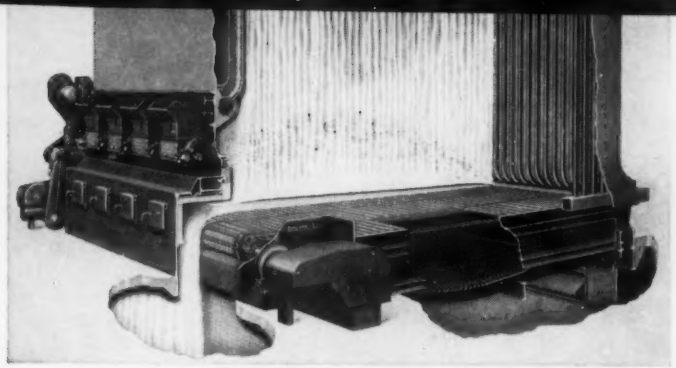

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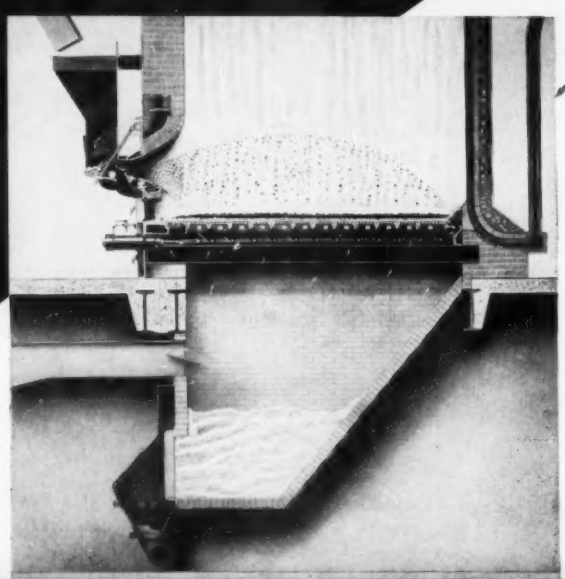

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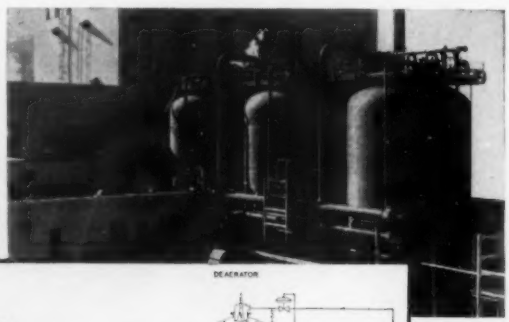
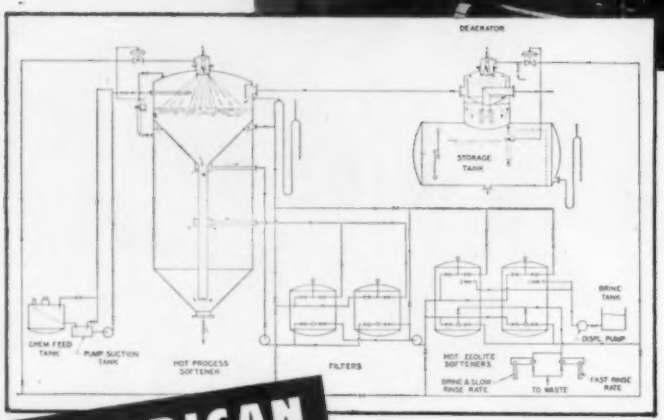
On the right, three of seven American softeners installed in a large mid-western refinery. Below—a typical Sludge Blanket Hot Process Softener.





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More PLANT PROBLEMS

Begins on page 142

Grounding neutrals

Continued from page 222

grounding is applied to systems at 22 kv and higher.

Grounding an existing system can introduce problems. Transformers, for example, must have wye-connected secondaries, or grounding transformers must be used. In some low-voltage systems it is desirable to ground one phase as corner-of-the-delta. In new systems, purchase of the right equipment will provide a neutral for grounding. Standard load-center substations are now available with wye-connected secondaries in all standard kva ratings.

Plan new systems for neutral grounding. It's good design procedure and insures better operation.

DEAN E ANDERSON *Neenah, Wis.*

BEGIN GROUNDING at the power source, whether a generator or transformer. Wye windings give easiest grounding. Ground each voltage level to prevent leaks from a higher to a lower voltage.

Protect motors and other equipment with breakers in each phase, together with fuses at the substation switches. Protect breakers in leads to substations with fuses at the main distribution switches.

Use impedance or resistance grounding for voltages over 2300. Limit current flow to the maximum 3-ph short-circuit current. If *SJ* generates his own current, he'll need differential relays to drop out the main, field and neutral breakers simultaneously to prevent eddy-current damage to the machine.

HOWARD HOLCOMBE
Los Alamos, N. M.

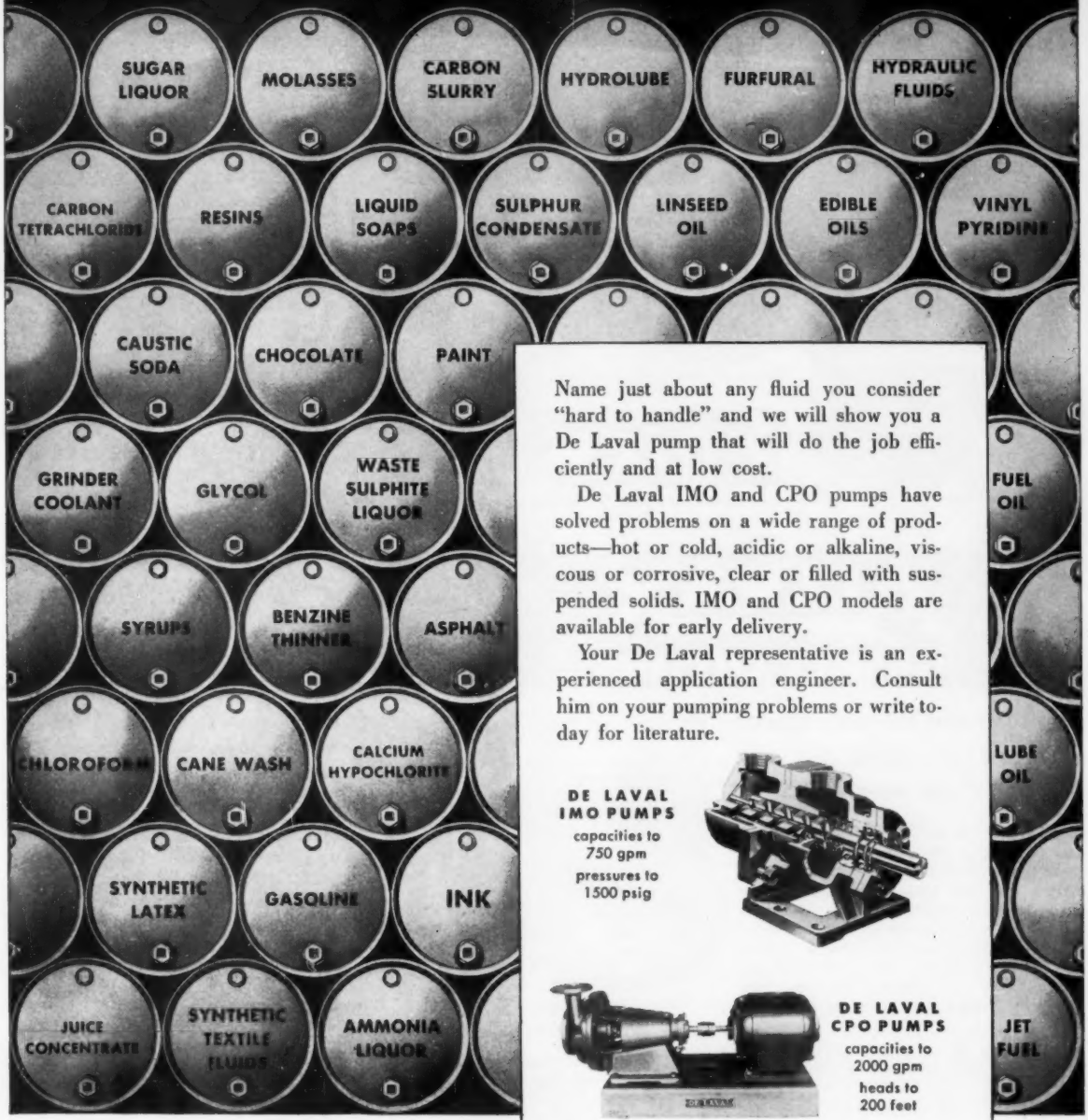
NEUTRALS, METAL RACEWAYS and conduit in systems under 250 v require grounding to reduce fire and safety hazards. With right connections, raceways and conduit will always be at ground potential.

Should any phase short to the raceway, the protective fuse will blow, preventing raceway potential from rising above that of the ground. Current leakage may cause raceway to become hot enough to start a fire. Grounded neutral protects against transformer-winding failure and accidental shorts between high and low phases.

Experience shows that grounded systems have faster fuse action. It is undesirable to ground only part of a system, leaving the remainder unprotected.

Ordinary light bulbs are suitable ground detectors on low-voltage sys-

Which of these is your pumping problem?



Name just about any fluid you consider "hard to handle" and we will show you a De Laval pump that will do the job efficiently and at low cost.

De Laval IMO and CPO pumps have solved problems on a wide range of products—hot or cold, acidic or alkaline, viscous or corrosive, clear or filled with suspended solids. IMO and CPO models are available for early delivery.

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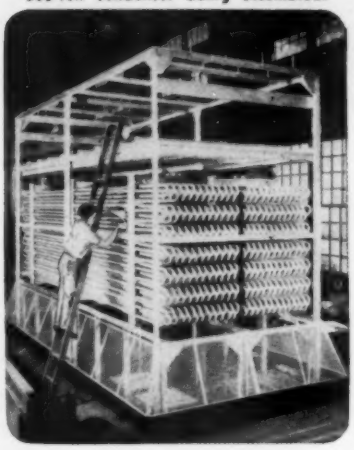
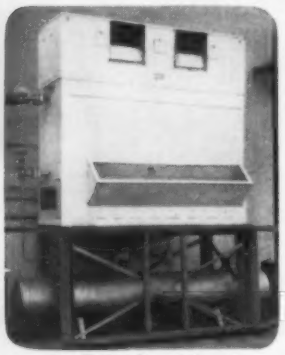
300-ton condenser being assembled.



FRICK Evaporative Condensers Save Water and Power!

Whether you operate an air conditioning system, a processing plant, or a hotel . . . if you use refrigeration, you can save 95% of the cooling water . . . and lots of money . . . with these efficient condensers. They combine a condenser and a cooling tower . . . evaporate 5% of the water instead of throwing all of it away. Built in 12 sizes, for use with either ammonia or Freon. Ask for Bulletin 234 on these superior condensers: write

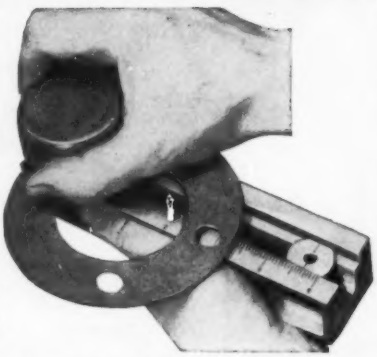


Small Condenser in use.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.
Also Builders of Power Farming and Sawmill Machinery

ALLPAX
GASKET CUTTERS

Here's low cost insurance against high cost shutdowns . . . a "MUST" for maintenance



Here's the way to cut BOLT HOLES as well as gaskets, quickly, accurately and make you ready for any emergency. The time saved in cutting your own gaskets will pay for this handy, simple tool over and over again. You just can't afford to be without it in your plant. ALLPAX GASKET (and BOLT HOLE) Cutters cut felt, cork, rubber, compressed asbestos sheet, etc. up to ¾" thick. Get yours from your nearest distributor . . . or us direct . . . NOW!

ALSO: Packings for all services; special packings to order; valve discs; retainer rings; molded and mandrel-cut packing rings; packing hooks. Packing in coil, ring or loose form.

Make your packing problems ours.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.

Superheat Sheet Packing . . . Oil Proof Sheet Packing . . . Red Rubber Sheet Packing . . . Diaphragm Sheet Packing . . . Cloth Inserted Sheet Packing

More PLANT PROBLEMS

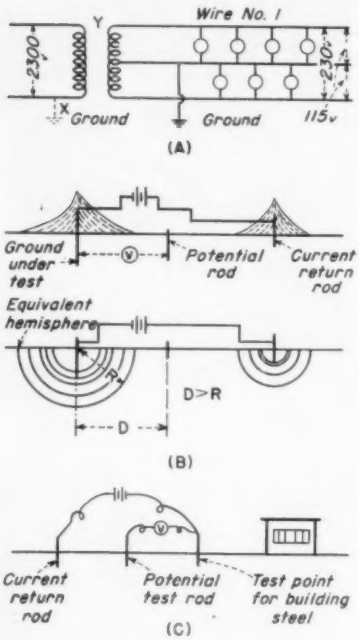
Begins on page 142

Grounding neutrals

Continued from page 224

tems. One side of the bulb is connected to the phase, the other is grounded. When a ground occurs, the light on that phase dims. Lights are satisfactory for higher voltages if potential transformers are also used.

A M DAMEROW *Elk River, Minn.*



GROUND the neutral wire of the secondary circuit of a transformer to a pole or in a manhole and at the service switch in building. Then if lightning hits system, the primary is grounded at *X*, sketch *A*, and transformer insulation between primary and secondary breaks down at *Y*. Without a permanent ground, potential of wire No. 1 is 2300 v above ground potential. This is a serious hazard. Use a No. 6 copper wire to ground secondary; provide one ground for at least every 500 ft of secondary length.

For high-voltage lines, Y-connected transformers are cheaper than delta—because they need not be insulated for as high a voltage if the neutral is grounded.

Locate power feeders entering a building as close as possible to the service switch. Then all conductors and equipment in the building will be dead when the switch is open.

Distribution systems of 300 v and less are usually grounded. Inside the building, the grounded conductor should

NEW "Small" boiler is a Big Quality package!

Available up to 80 hp — heating or processing — steam or hot water. A complete unit from a single source.

CLEAVER-BROOKS modern CB boiler

NO BOILER HAS EVER OFFERED SO MANY ADVANTAGES AND QUALITY FEATURES AT SUCH LOW INITIAL COST

● This NEW CB boiler has EVERYTHING needed to bring *big boiler standards* to commercial, industrial and institutional users with small capacity requirements. Despite its unusual, compact size you get big boiler performance — from matched-quality components, proved the world over on thousands of Cleaver-Brooks self-contained units.

Get all the facts NOW on how the new CB can help you save dollars. Make it a point to see . . . and *hear* the most silent-running, biggest boiler value available anywhere!

gives you all the quality features of time-tested self-contained design

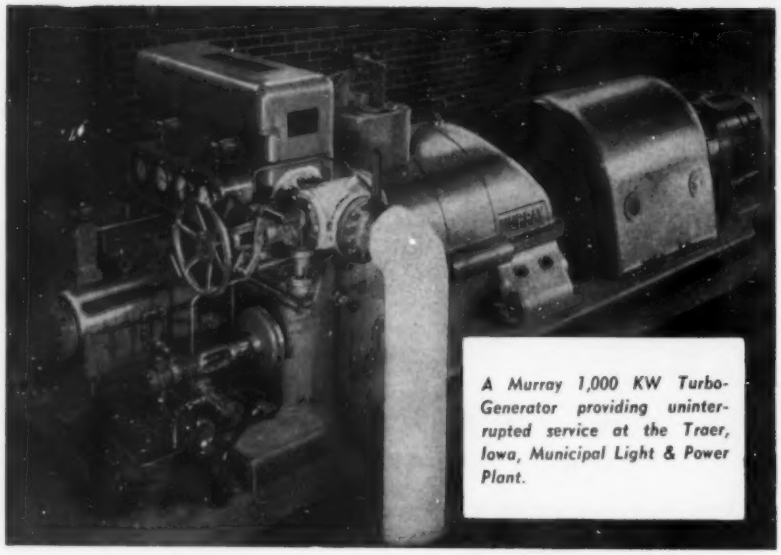
- **FOUR-PASS FIRETUBE CONSTRUCTION** — longer gas travel scrubs heat from flame — means lower fuel costs — guaranteed efficiency of 80% when firing with oil.
- **SILENT OPERATION** — even at peak load this boiler more than meets the low sound levels required for schools, hospitals, institutions.
- **FULL FIVE SQUARE FEET** — of heating surface per boiler hp — for longer service life and low maintenance.
- **FUEL FLEXIBILITY** — burns available light oil, gas, or combination oil/gas — simple, quick fuel changeover on oil/gas models.
- **FAST, EASY MAINTENANCE** — front and rear doors hinged for fast inspection, cleaning or servicing boiler.
- **AUTOMATIC SAFE OPERATION** — all controls centralized and conveniently located — modern electronic combustion control is standard equipment.
- **COOLER BOILER ROOM** — fiber glass blanket insulation and 16 gauge metal sectional lagging are non-corrosive, moisture and heat resistant.
- **FULLY APPROVED** — by Underwriter Laboratories; conforms to ASME codes; factory tested before shipment.

Call your nearest CB boiler representative (see your phone directory) or send for this illustrated catalog describing the NEW CB — designed by Cleaver-Brooks, originators of self-contained boilers.

Cleaver Brooks

Cleaver-Brooks Company, Dept. G, 301 E. Keefe Ave., Milwaukee 12, Wisconsin, U.S.A.
Cable Address: CLEBRO — Milwaukee — All Codes.
Originators of the Self-Contained Boiler

Murray Turbines



A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.

● A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electrical load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a *must*.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

More PLANT PROBLEMS

Begins on page 142

Grounding neutrals

Continued from page 226

have a white covering or braid to distinguish it from the others. Don't fuse or open this conductor unless the others are opened at the same time. Motors need be grounded at only one point if each section makes a good electrical connection with the next.

Use resistance grounding wherever possible. Test grounds at regular intervals to see if connections are good. Usually, a new ground must be installed when the resistance of an existing one exceeds 25 ohms.

Sketches *B* and *C* show precautions that must be taken for accurate ground resistance measurements. Use a megohmmeter to make measurements.

H B WAYNE *Brooklyn, N. Y.*

DECIDE EACH CASE on its own merits. Pertinent factors include: system size, number of generators, type of utility feeds, number and character of branch feeders, physical extent of the system, type of lines or cables, voltage, degree of service continuity needed, maintenance allowable, cost and feasibility of relaying needed, and cost of grounding equipment.

Only when all these factors are evaluated for a given plant can a suitable solution be reached. There is no general rule stating that every system should be grounded or ungrounded.

NORTON SAVAGE
St. Clair Shores, Mich.
C O VON DANNENBERG
Brooklyn, N. Y.

INSURANCE COMPANY will no doubt have some ideas for *SJ* on system grounding. I suggest he consult them for recommendations applying to his particular plant. After that, see a good consulting engineer.

IRA A BUTCHER *Cincinnati, O.*

BY ALL MEANS ground neutrals. Real advantages can be gained. Many plants run for years ungrounded and never seem to get into trouble because heavier insulation is used throughout.

Ground all voltage levels. Interconnect the various neutral systems. Ground them solidly as prescribed by law, local regulations and good practice.

The ideal connections are wye-delta. Current is generated in a grounded wye generator, receiving and stepup transformers are delta with outgoing wye-connected winding. Stepdown transformers should be delta-wye, etc. But these connections are not always eco-

(*Continued on page 234*)

G-R fin-fan

more *than ever your best buy in*

AIR-COOLED HEAT EXCHANGERS

more *Applications*

The **fin-fan** exchanger is readily adaptable to practically every condensing and cooling application, particularly when the use of cooling water involves problems of supply, cost, scale or corrosion. Such flexibility is just one of many features, which make the G-R **fin-fan** your best investment in air-cooled apparatus.

more *Advantages*

Many important design and construction advantages are incorporated in the **fin-fan.** These include 100% effective cooling surfaces; maximum heat transfer afforded by exclusive G-R K-Fin Cooling Sections; fully prefabricated structure; predrilled supports, providing for addition of future units; *plus* bell-type fan ring for maximum efficiency with minimum horsepower required for fan.

more *Installations*

More square feet of K-Fin tubing, which forms the heat transfer surface, are being used in more types of air-cooled installations than any other design. Reason? Dependable ratings, design and workmanship backed by over 85 years of specialized experience in building quality heat transfer apparatus for varied services all over the world.

more

Dependable because completely G-R

The new G-R **fin-fan,** *completely G-R,* can be depended upon for structural strength, peak operating efficiency, ease of installation, operation and maintenance. It is a complete self-sustained unit combining the best transfer service available with tested and proved air circulation equipment. As a result of exhaustive tests conducted on the complete equipment over a six month period G-R can offer you *guaranteed performance* based on actual test data. This is just one more important reason why the new G-R **fin-fan** is your best buy in air-cooled heat exchangers.

GR331

G-R HEAT TRANSFER APPARATUS

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

fin-fan Air-Cooled Heat Exchanger

Depend on LADISH

To Meet All Your Fittings Needs With an Unsurpassed Range of Sizes and Materials

L
TO MARK PROGRESS

1 BUTT WELDING FITTINGS

2 A.S.A. FORGED FLANGES

3 FORGED SCREWED OR SOCKET WELDING FITTINGS

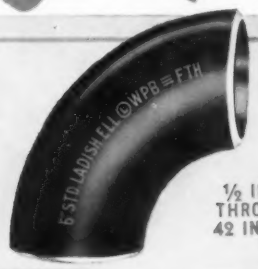
4 T.E.M.A. HUB & RING FLANGES

5 LONG WELDING NECKS

6 LARGE DIAMETER FLANGES AND RINGS

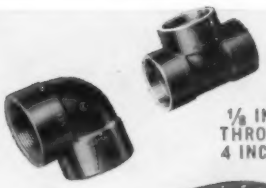
Available in...

Complete Service . . .



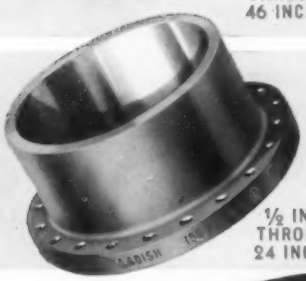
½ INCH THROUGH 42 INCHES

½ INCH THROUGH 24 INCHES



⅛ INCH THROUGH 4 INCHES

6 INCHES THROUGH 46 INCHES



½ INCH THROUGH 24 INCHES

UP THROUGH 20 FEET O.D.

CARBON, STAINLESS AND ALLOY STEELS, ALUMINUM, NICKEL AND OTHER FERROUS AND NON-FERROUS METALS

To Meet Your Entire Fittings Needs with a Line Complete In All 6 Major Types

For dependable service that results from an ideal combination of broad line and ample stock . . . specify and buy LADISH . . . the Controlled Quality line that offers a complete range of sizes, types, weights, pressure ratings and materials needed for virtually any piping installation. Your local Ladish distributor's ample stock is backed by complete factory inventories to keep your piping jobs on schedule. So, for *complete service* in fittings . . . specify and buy LADISH.

For your new 304-page Ladish Fittings Catalog, No. 55 contact your Authorized Ladish Distributor, your local Ladish District Office, or write to Ladish Co., Dept. PO, Cudahy, Wis.

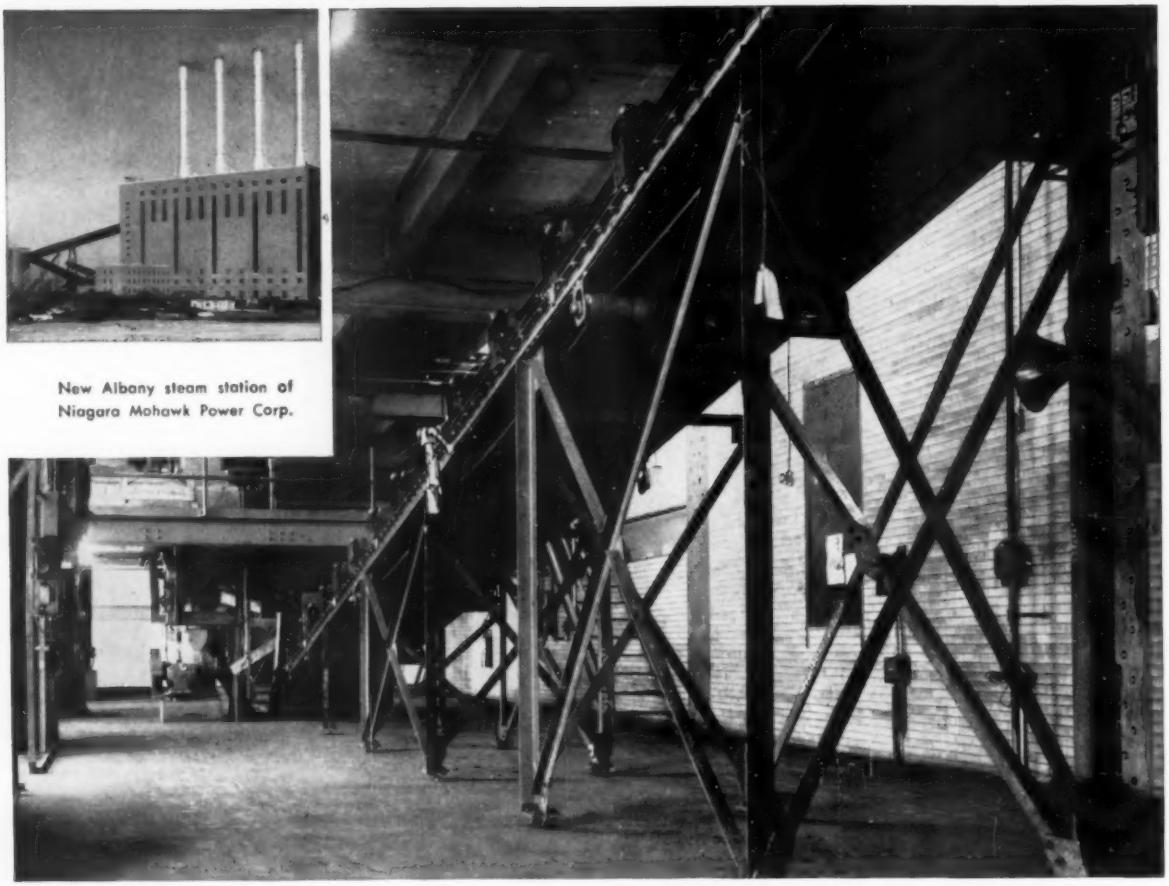
THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED TO ONE STANDARD OF UNSURPASSED QUALITY

LADISH CO.

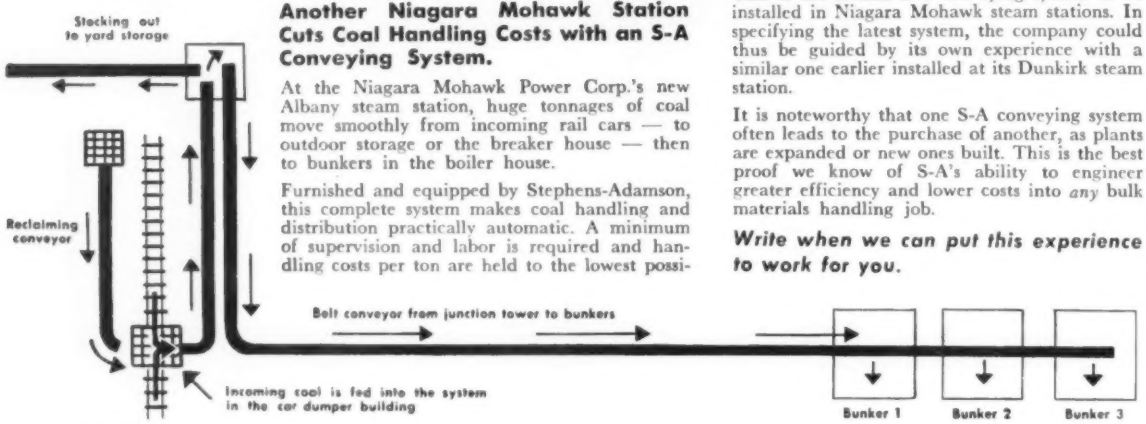
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.

New Albany steam station of Niagara Mohawk Power Corp.



Coal "Highway" for a Steam Plant


Stocking out to yard storage
Reclaiming conveyor
Belt conveyor from junction tower to bunkers
Incoming coal is fed into the system in the car dumper building
Bunker 1
Bunker 2
Bunker 3

Another Niagara Mohawk Station Cuts Coal Handling Costs with an S-A Conveying System.

At the Niagara Mohawk Power Corp.'s new Albany steam station, huge tonnages of coal move smoothly from incoming rail cars — to outdoor storage or the breaker house — then to bunkers in the boiler house.

Furnished and equipped by Stephens-Adamson, this complete system makes coal handling and distribution practically automatic. A minimum of supervision and labor is required and handling costs per ton are held to the lowest possible level. Virtual elimination of coal dust and dirt also reduces plant housekeeping time and expense.

This is the second S-A conveying system to be installed in Niagara Mohawk steam stations. In specifying the latest system, the company could thus be guided by its own experience with a similar one earlier installed at its Dunkirk steam station.

It is noteworthy that one S-A conveying system often leads to the purchase of another, as plants are expanded or new ones built. This is the best proof we know of S-A's ability to engineer greater efficiency and lower costs into *any* bulk materials handling job.

Write when we can put this experience to work for you.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

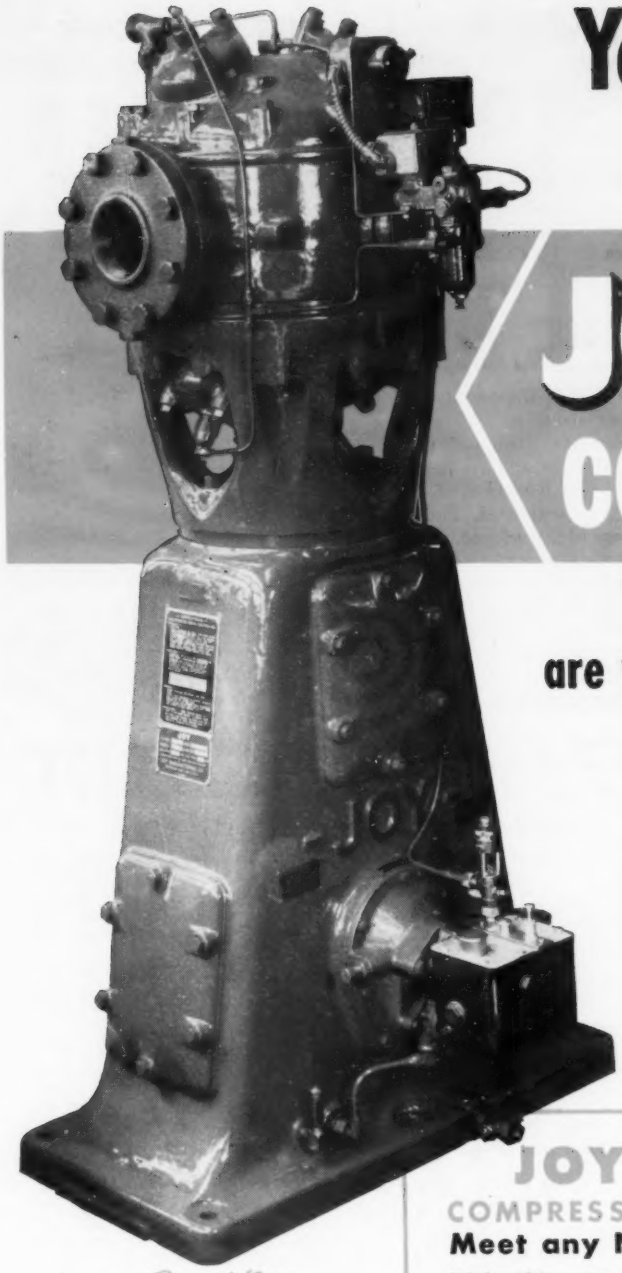
STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Ill. • Los Angeles, Calif., Belleville, Ont.

Engineering Division
Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division
A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.



You'll find them only in the

JOY WG-9 COMPRESSOR

These Exclusive Features are worth Money to you!

Only the JOY WG-9, in its class, offers replaceable crosshead guides and cylinder liners, and full force-feed lubrication—features that will save you money in operating and maintenance costs. Unique truncated pistons and angled over-size "Dual-Cushion" valves assure higher valve capacity, better heat dissipation, lower air friction and elimination of valve pounding.

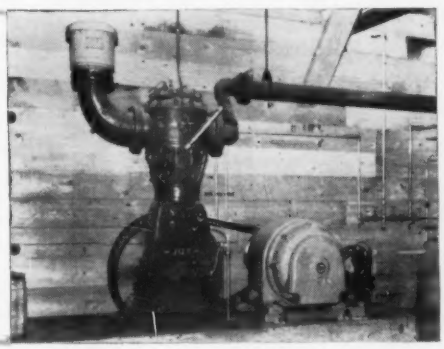
The WG-9 is a water cooled, double acting, single stage, heavy duty compressor for use where medium amounts of air are needed or for supplementary service in high air-requirement industries. Vertical design minimizes vibration and cuts required floor space. Foundation is but a simple concrete pad.

15 SIZES • 30 to 150 lbs. psi • 172 to 881 CFM

Consult a Joy Engineer

JOY COMPRESSORS Meet any Need

High and low pressure compressors, oil free compressors, boosters and vacuum pumps—Joy builds a type and size for every need. • Let us handle *your* air-supply job.



Over 100 Years of Engineering Leadership

W&D 1 4030

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING • PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

FOR REPLACEMENTS ORDER

ERNST

MASTER HIGH PRESSURE

GAGE GLASSES

FIG. 14 MASTER STANDARD RED LINE and also FIG. 12 MASTER STANDARD CLEAR *Up to 500 lbs.*

Noted for high pressure and temperature.

RUBBER GASKETS

HIGH PRESSURE COMPOSITION

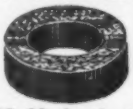


FIG. 22—Standard

FIG. 21—Lip Mold

Manufactured in all sizes to fit your water gages and valves.

Specify:
B—Inside Diameter
A—Outside Diameter
C—Thickness

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.

Gentlemen:
Please send me **BULLETIN 1-6-54** today

NAME .....
COMPANY .....
ADDRESS .....

More PLANT PROBLEMS

Begins on page 142

nomical, or existing equipment prevents their use.

Relays, resistors and ground detectors should be carefully chosen and applied if *SJ* wants best results.

JULIO COLON *Mexico, D. F.*
E A ROBERTS *Carlsbad, N. M.*
C G HOWARTER *Canton, Ill.*

AIR COMPRESSOR

Continued from page 135

This encourages early purchase of the unit, if the lessee wants it.

In some agreements, 100% of the rent paid during the first 30 days is recaptured on purchase. Beyond the first 30 days, only 80% is recaptured. There are many variations of this scheme.

Remember, renting a compressor is not cheaper than buying one unless you have a special set of conditions in your plant. No fixed rule can be given telling you if renting or buying is cheaper.

Stationary-compressor rates *

High pressure with motor and belt or coupling

Capacity cfm	Mo	Wk	*Day*
To 46	$ 69	$ 24	$ 8
46-55	74	25	8
55-72	96	31	11
72-95	109	36	12
95-125	133	41	13
125-160	174	55	18
160-215	201	68	22
215-270	249	79	26
270-370	295	94	30
370-470	341	107	36
470-570	385	120	41

High pressure with gas engine and belt or coupling

To 30	$ 55	$ 21	$ 6
30-46	75	27	9
46-55	108	37	11
55-72	121	40	14
72-95	130	44	15
95-125	170	57	19
125-160	211	70	24
160-215	278	95	30
215-270	359	119	40
270-370	455	150	52
370-470	582	195	64
470-570	714	236	79

Low pressure with motor and belt or coupling; 40 psi and under

To 900	$330	$111	$37
900-1200	482	160	54

*Rounded off to the nearest dollar. Rental rate applies only to compressor; tanks, switches, aftercoolers, etc, are established on the basis of a 6-month payout.

HERE'S THE RIGHT COMBINATION FOR

LONGER *FURNACE LIFE*

ADAMULL FIRE BRICK AND ADAMANT FIRE BRICK CEMENT

The above photo shows a multi-drum boiler in a nationally known chemical plant . . . being completely rebuilt with ADAMULL Fire Brick, bonded with famous ADAMANT Fire Brick Cement . . . this combination insures *longer furnace life* despite high temperatures and extreme spalling conditions.

ADAMANT Cement: ADAMANT has exceptionally high bonding strength at room temperature, which increases as the temperature rises. Impartial laboratory tests show that ADAMANT has a bonding strength of 800 lbs. at room temperature; 1,270 lbs. at 2,600°F. This greater bonding strength protects the structure at the joints, where failure usually begins . . . therefore, linings last longer; production is maintained, repair costs and production materials saved; less "outage".

ADAMANT—Ready-Mixed and Easy to Use—available in air-tight drums of 100, 250 and 500 lbs. capacity. Write for useful literature about ADAMANT.

ADAMULL Fire Brick:

A super duty fire brick for use in furnaces operating at high temperatures and for the "tough spots" in all furnaces. ADMULL super duty brick will withstand more temperature, more slagging, more heat shock than first quality fire brick, and meet the A.S.T.M. specfication for Super Duty Brick. Write for Literature.

We'll gladly furnish the address of the BOTFIELD Distributor near you.

BOTFIELD

REFRACTORIES CO.
784 S. Swanson Street, Philadelphia 47, Pa.
In Canada
Canadian Botfield Refractories Co., Ltd.
171 Eastern Avenue, Toronto

Lunkenheimer builds valves to *last*. Back in 1928, a 10-inch Steel Gate Valve was installed in the electric plant in Hamilton, Ohio. After 25 years of steam service at 625°F., the valve was *relocated* on a 725°F. steam line serving a new 10,000 kilowatt turbine generator. *A quarter century of service* — and this Lunkenheimer Steel Valve starts a new job!

This is typical of the dependable service that's built into every Lunkenheimer Valve. Take advantage of Lunkenheimer leadership in design, materials, and workmanship. Specify and use Lunkenheimer Valves — service-engineered for *your* applications. The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio

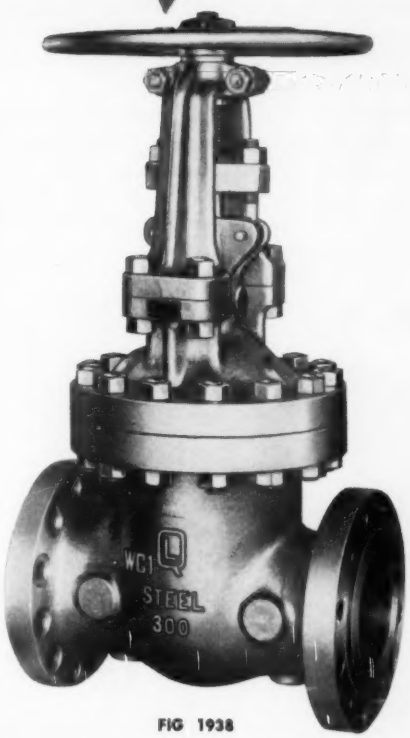


FIG 1938

The cost of a Lunkenheimer Valve gets smaller and smaller and smaller with each passing year of dependable service.

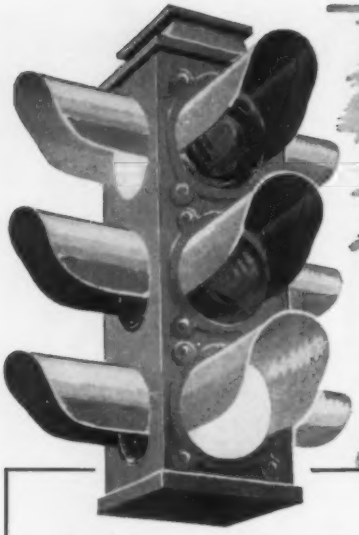
LUNKENHEIMER QUALITY

STEEL • IRON • BRONZE

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-253-10



DRAFT FANS

GO

on GREEN

Packaged Boilers Deserve Good Fans, Too!

The same engineering talents and the same careful construction go into the many stack supporting draft fans we have designed for the so-called "packaged" boilers. In some ways, engineering faces more difficult design problems because of the utmost efficiency required in a relatively small space.

Green Stack Supporting Draft Fans are practical, too. They are readily accessible for inspection and maintenance. Shafts and wheels are removable endwise without disturbing the stack or other structural members.

To those manufacturing "packaged boilers" or to those operating them with fans that don't seem to be doing the proper kind of a job or where maintenance seems too high, we offer the services of our experienced fan engineers to (1) design fans suitable for the boiler or (2) study the problem and recommend the remedy.

Our New Bulletin 168 gives details of our Stack Supporting Draft Fans. Write for a copy.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

REFRIGERATION SYSTEM

Continued from page 129

to see why care and patience in leak testing during installation pay big dividends in the long run.

Lubrication. Freon refrigerants require about one ounce of oil for every ten ounces of Freon. Most oil manufacturers recommend the proper oil to go with your refrigerant. Low-temperature applications generally require an oil of 150 ssu at 100 F, while comfort air-conditioning units use a more viscous lubricant—about 300 ssu at 100 F.

Most satisfactory way of adding oil is to utilize vacuum created at compressor suction. An oil line, hooked up to the compressor suction and equipped with a compound gage and valve, is submerged with its open end in the oil. With the valve closed, the compressor is operated until a reading of about 15 inches mercury vacuum is read on the compound gage. Open the valve and allow the vacuum to pull the correct amount of oil into the system. Don't forget to keep more oil in the supply tank than you need. If the supply-tank oil level drops below the open end of the fill line, air will enter the system causing high head pressure and moisture in the lines. Be sure to close oil-fill valve and compressor-suction valve before removing oil-supply line.

Adjustments. Before the refrigeration system is ready for service, valves and controls must be checked for proper setting to give specified operating pressures and temperatures. Position the condenser-cooling-water supply valve so it automatically opens and closes to maintain the correct head pressure. High head pressures put an extra load on the compressor. This condition is a result of insufficient cooling water. Too much cooling water causes excessively low head pressures. As a final check on this valve, shut down the machine. The valve should then be fully closed. If water continues to flow, inspect the valve seat for a burr, dirt or other foreign material that may be holding it open.

Expansion valves are usually factory set for about 10 F superheat at the evaporator outlet. So don't touch this piece of equipment until the unit has been operating for several cycles. Opening valve decreases superheat (increases refrigerant flow).

The high-pressure cutout switch opens the electrical circuit when high-side pressure exceeds safe limits. This control is set at 150 psi for Freon-12 units whose head pressures are 115 to 125 psi. The low-pressure cutout switch, connected to suction side of the compressor, controls refrigerator-box temperature. To set this unit, allow the machine to operate from one half to one hour. Take box temperature and read suction

STOPS PIPE BREAKS IN HUGE POWER DAM

PENFLEX

FLEXIBLE METAL TUBING

is tight as a pipe . . . but *flexible!*

IT WAS BAD ENOUGH when one of the 12 big 220,000-volt transformers had to be disassembled for repairs. But when the cooling water pipes had to be replaced because of frequent leakage—that's when the Penflex Engineer was called in.

He recommended 4" bronze interlocked Penflex Flexible Metal Hose assemblies to replace the rigid piping. Gone was pipe and joint leakage. Gone, too, were machining, heating, and bending operations and misalignment headaches. Now a faulty transformer is switched in one-third the time . . . power speedily resumed . . . man-hours saved. Flexible Penflex makes cooling-pipe failure a thing of the past.

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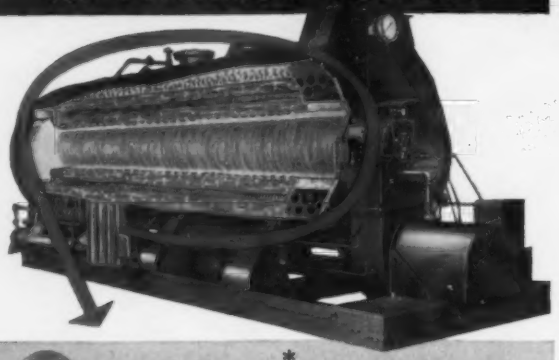
THE BIG DIFFERENCE IN PACKAGE BOILERS



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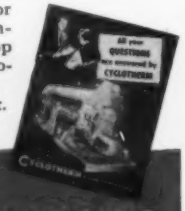


CYCLOTHERM STEAM GENERATORS

REFRIGERATION SYSTEM

Continued from page 236

pressure. Get corresponding suction temperature from tables. Difference between box and suction (coil) temperatures remains approximately constant. Decide on desired box temperature and get its corresponding pressure from tables. Cutout-switch pressure is equal to box pressure minus pressure difference between coil and box.

For automatic defrosting, set cut-in switch about two psi above pressure corresponding to refrigerant freezing temperature. For Freon-12 this is 34 to 35 psi.

One last tip: Don't forget to oil motor before starting machine.

After all settings and adjustments have been made, allow the unit to operate continuously for 24 hours. Then check important pressures and temperatures. These readings point the way to any final adjustments that may be necessary. If the system has been properly sized for the job and proper installation practices are carefully followed, you can expect and get trouble-free performance from your modern refrigeration system.

More FREE BULLETINS

Continued from page 176

HEAT EXCHANGERS

18 **Tubular electric heater** for heating viscous liquids. Illustrated 2-color, 4-page bulletin 202. Turbine Equipment Co, Hynes Electric Heating Div, PO Box 578, Westfield, N. J.

19 **Electric heaters** for oil have automatic temperature control. Photos, diagrams and complete capacity ratings. Four-page bulletin 709A, Hauck Manufacturing Co, 124-136 10th St, Brooklyn 15, N. Y.

20 **Heat exchangers** used in cooling or controlling of temperatures of industrial liquids. Photos, diagrams and examples of application. Three-color, 4-page bulletin 120, Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.

MAINTENANCE & SAFETY

21 **Corrugated sheeting** maintenance manual contains photos, instructions and data sheets. Eight-page bulletin, file No. 154. Fabricated Products Co, Water St, W Newton, Pa.

22 **Scaffold selector manual,** applied to industry. Two-color, 4-page bulletin G205R, Patent Scaffolding Co Inc, 38-21 12th St, Long Island City 1, New York.

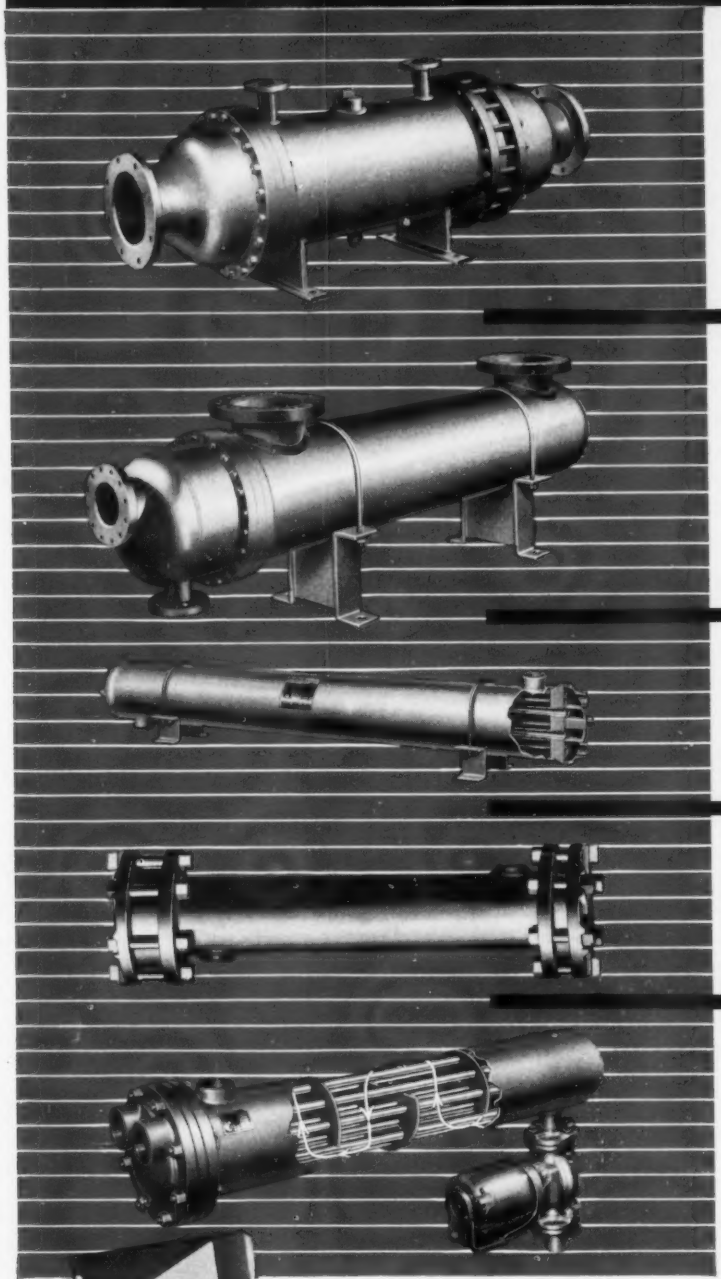
23 **Rupture disc** for low pressure and highly corrosive applications. Construction, operation, pressure ranges and manufacturing data. Fully illustrated 2-color, 6-page folder 77-30, Black, Sivalls & Bryson Inc, 7500 E 12th St, Kansas City 26, Mo.

24 **Washing machines** for industrial cleaning applications. Photos and complete specs. Two-color, 4-page bulletin. Storm-Vulcan Inc, 225 Burbank St, Dallas, Texas.

25 **Heat-resisting finishes** for temperatures as high as 1600°. Physical properties, economic advantages and application directions. Two-color, 4-page bulletin 5311, General Paint Corp, 2627 Army St, San Francisco 19, Calif.

(Continued on page 240)

B&G HEAT EXCHANGERS
...FOR EVERY TYPE OF SERVICE!



TYPE "OC" STRAIGHT TUBES

Sound design, plus precision manufacture, assure efficient operation. Removable tube bundle easily cleaned inside and out. Minimum free annular area and baffles with close tolerances reduce by-passing around the tube bundle. Other features include high tensile strength bolting, full thickness tube sheet and ample metal ligaments between tube holes. ASME quality at no extra cost.

TYPE "U" U-BEND TUBES

Recommended where the lower price of a single tube sheet unit is a necessary economy. These exchangers are also desirable where temperature differential across the tube bundle is extreme. Features include external gaskets, full tube bundle and close tolerance baffles for minimum by-passing. Metal ligaments between tube holes are extra large for internal strength. High tensile strength bolting. ASME quality fabrication.

FUEL OIL PRE-HEATERS

Reduce viscosity of heavy oils to permit pumping—control temperatures for proper atomizing of different oils. Units are available in straight tube and U-bend construction, for steam or water as the heating medium and with 2 to 10 passes.

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Efficient "air tube" design (air in tubes, water in shell) makes more effective use of cooling surfaces and reduces pressure drop. Cooling water is directed back and forth across tubes by baffles and moves in a direction counter to air flow.

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Produce large volumes of hot water from amazingly small units. Boiler water is pumped by a B & G Booster through the shell, greatly increasing the capacity of the heater. This also permits close control of service water temperature. Because of pumped circulation, connecting pipes and fittings are reduced in size, saving material and labor. "WU" Heater is instantaneous—no tank needed.

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More FREE BULLETINS

Begins on page 176

26 **Portable steam cleaner** operates at 80 to 125 psi steam, independent of city water pressure. Photos and specs. Two-color, 4-page bulletin, Turbo Machine Co, Lansdale, Pa.

27 **Flame failure explosions.** A nontechnical explanation of causes and available safeguards. Twelve-page bulletin CP21, Combuston Control Corp, Dept NB-8, 718 Beacon St, Boston 15, Mass.

28 **Explosion proof housing** for enclosing such electrical equipment as fuses, relays and motor starters. Two-page bulletin F-254, The Adalet Manufacturing Co, 14300 Lorain Ave, Cleveland 11, Ohio.

MATERIALS HANDLING

29 **Materials handling equipment** catalog describes complete line of boxes, skids, hand trucks, etc. Illustrated 42-page booklet. Palmer-Shile Co, 12631 Mansfield Ave, Detroit 27, Mich.

30 **Shock-absorbing casters.** Twenty-page catalog lists types of casters and mountings available. Shows load ratings for each type and size. Bassick Co, Bridgeport 2, Conn.

31 **Rubber conveyor belting** as applied to industrial use. Photos, installation and technical data. Thirty-page catalog. Hamilton Rubber Manufacturing Corp, Trenton 3, N. J.

MECHANICAL TRANSMISSIONS

32 **Silent chain drives** for a broad range of applications. Fully illustrated 88-page catalog. Complete specs and engr data. Book 2425, Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

33 **Power transmission equipment.** Full specs and photos of variable speed pulleys, V-belts, sheaves, motor bases, countershafts and transmissions. Two-color, 24-page catalog. Lovejoy Flexible Coupling Co, 4870 W Lake St, Chicago 44, Ill.

34 **Cam clutches,** *series 200,* for indexing, over-running and backstop machine drive applications. Typical installation drawings, complete specs and application data. Two-color, 4-page bulletin C12-54, Morse Chain Co, 7601 Central Ave, Detroit 10, Mich.

35 **Metal chain.** Photos and reports of laboratory tests and field applications. Two-color, 12-page bulletin 53-56, Chain Belt Co, Dept P R, Milwaukee 1, Wis.

★ **Rotocured transmissions,** conveyor and elevator belting. Complete specs and construction data. Illustrated 28-page catalog. ★Request direct on company letterhead to Belting Dept, Boston Woven Hose & Rubber Co, Box 1071, Boston 3, Mass.

METERS & INSTRUMENTS

36 **Electrostatic measuring gun.** A portable instrument specifically developed for measuring electrostatic charges on surfaces. Two-page bulletin 123, Herman H Sticht Co Inc, 27 Park Pl, New York, N. Y.

37 **Single circuit pyrometers.** A concise discussion of pertinent facts about pyrometry in general industry entitled *Temperature Indications.* Illinois Testing Lab Inc, 420 N LaSalle St, Chicago 10, Ill.

38 **Portable temperature indicators** for heavy duty use. Describes the potentiometer indicator and the resistance thermometer. Photos and specs. Two-color, 8-page bulletin A-303-1, The Foxboro Co, Foxboro, Mass.

39 **Pneumatic transmitter** with pressure gage for remote indicating, recording or controlling of pressures. Photos, diagrams and specs. Two-page bulletin 1025, Penn Industrial Instrument Corp, 4110 Haverford Ave, Philadelphia 4, Pa.

(*Continued on page* 242)

MURCO SPILLWAY GATE HOISTS

8 MURCO Spillway Gate Hoists, 125 ton capacity, installed by the Washington Water Power Co., Cabinet Gorge Project, Clark Fork River, Idaho.

DESIGNED AND BUILT TO MEET ALL REQUIREMENTS FOR ANY SIZE POWER DAM

Murco Gate Hoists are designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist. In over 50 years of designing and building gate hoists, we have developed designs for many gate hoist problems. We may have designs and patterns to fit your special requirements. In planning gates or gate hoists, we suggest you write us before your over-all plans are complete . . . it may save time and money. We also build gate hoists to fit your plans and specifications.

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When a maintenance man installs a gate valve, he doesn't want to be called back to the same location in a week because it's leaking. And one sure way to avoid call backs is to use an O-B gate which features the Flexitite Disc.

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O-B bronze gate valves, featuring the Flexitite Disc, are available in sizes up to three inches, and for up to 200 pounds working steam pressure. Buy them from your Ohio Brass distributor.

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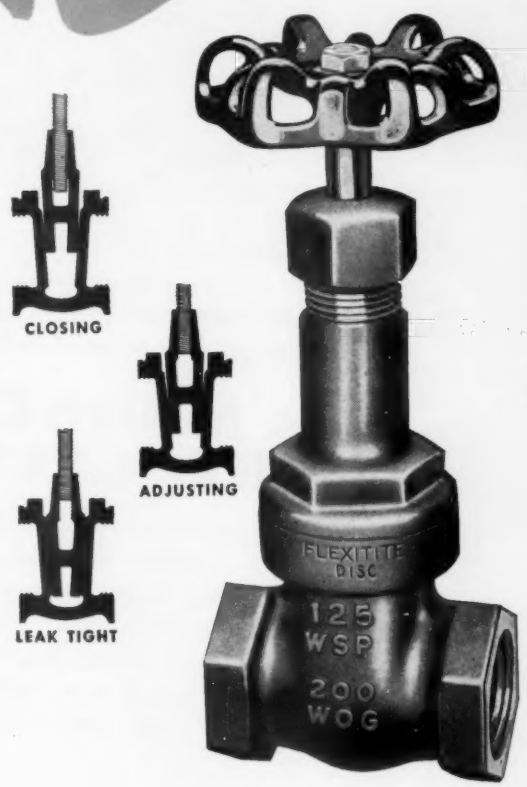
Mansfield, Ohio



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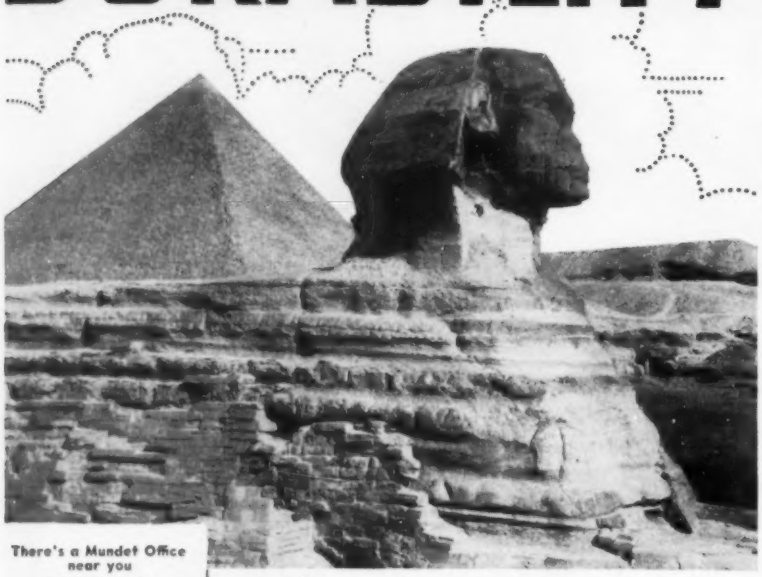

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Begins on page 176

40 **Electric tachometer.** Photos, technical data, diagrams and features. Sixteen-page bulletin 1153, The Esterline-Angus Co Inc, PO Box 596, Indianapolis 6, Ind.

41 **Pneumatic signal transmitter.** Schematic diagram and applications. Two-color, 4-page bulletin 9653-M, Hagan Corp, Hagan Building, Pittsburgh 30, Pa.

42 **Resistors and power rheostats,** devoted to wire-wound fixed and adjustable vitreous-enamel units. Descriptive data, line drawings, charts, curves and photos. Two-color, 27-page bulletin 79-8, P R Mallory & Co Inc, Resistor Div, Frankfort, Ind.

PIPING, VALVES, FITTINGS

43 **Unions and swing check valves.** Complete engineering data and specs. Twenty-four-page bulletin 11, Catawissa Valve & Fitting Co, Catawissa, Pa.

44 **Blow-off valves.** Photos, line drawings, cutaways and specs. Two-color, 18-page bulletin 12-D1, Edward Valves Inc, 1211 W 145th St, E Chicago, Ind.

★ **Fittings catalog** and piping handbook. Specs, dimensions and technical data on complete line. Full 304-page catalog. ★Request direct from Ladish Co, Cudahy, Wis.

45 **Jacketed valves** for heated-cooled gages. Photos, specs and cutaways. Two-page bulletins 220 and 221, Jerguson Gage and Valve Co, 80 Fellsway, Somerville 45, Mass.

46 **Flow control valves.** Photos, capacity ranges, connection and orifice sizes and engineering data. Two-color, 4-page bulletin. A-P Controls Corp, 2450 N 32nd St, Milwaukee, Wis.

47 **Valves** for instrument piping and general use. Application information, specs and photos. Four-page bulletin 234, Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

48 **Tubing steel** for elevated temperature and pressure application. Data on mechanical and physical properties, bending, welding and heat treatment. Four-page bulletin TDC 151, The Babcock & Wilcox Co, Beaver Falls, Pa.

49 **Solenoid valves** for automatic or remote control of steam, air, gas or liquid flow. Specs, applications, design and construction. Four-page bulletin 500A, J D Gould Co, 730 E Washington St, Indianapolis 2, Ind.

50 **Steam traps.** Photos, specs, pressures and weights. Two-color, 4-page bulletin 154, Steam Specialties Div, V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio.

51 **Flexon bellows.** Complete design guide for application and selection. Two-color, 16-page catalog 140, Flexonics Corp, 1301 S 3rd Ave, Maywood, Ill.

52 **Rotary joints.** Installation diagrams and photos. Two-color, 4-page bulletin. Key Co, 27th & McCasland Aves, E St Louis, Ill.

53 **Integral seat valves.** Complete service information, photos and blueprints. Four-page bulletin 531, Edward Valves Inc, 1201 W 145th St, E Chicago, Ind.

54 **Convoluted couplings** for low pressure and vacuum service joints. Photos, tables, dimensional diagrams and technical data. Two-color, 16-page catalog 55, Bellows Div, Solar Aircraft Co, 2200 Pacific Highway, San Diego 12, Calif.

55 **Cap screws** of heat-treated alloy steel. Photos, cross-sectional views and specs. Two-color, 4-page bulletin. Standard Pressed Steel Co, Box No. 577, Jenkintown, Pa.

56 **Drop-forged flanges.** Two-color, 24-page catalog. Photos, diagrams

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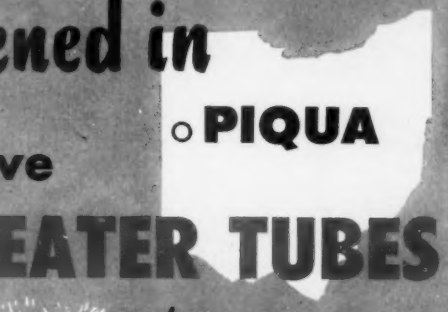

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We have long known that corrosion presents a real problem in steel preheater tubes used in boiler operation. We knew that the only partial solutions up until now were low sulphur, high cost fuel or the wasteful practice of high temperature exit of flue gases to discourage the condensation of sulphuric acid.

It was like mining for silver and stumbling onto gold . . .

Knowing full well that Vitralloy Tubes (steel lined with fused boro-silicate compounds) are acid-resistant, we had no worries about grade of fuel or flue outlet temperatures in an extended test at the Municipal Power Plant in Piqua, Ohio.

Obviously our confidence in Vitralloy's resistance to corrosion was justified by the test—why else would we be telling you?

But even more exciting from the standpoint of efficient boiler operation, we found that Vitralloy Tubes help solve the problem of clogging by making cleaning easy and practical.

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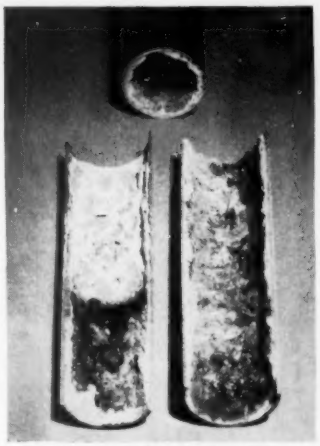
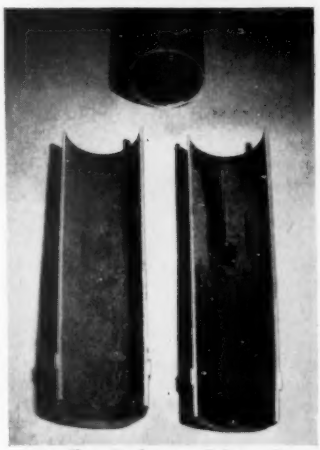


Ordinary Steel Preheater Tubes after six months normal use.



Vitralloy Preheater Tubes after six months use in the same air heater.

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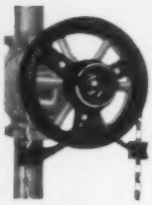
Adjustable
SPROCKET RIM
with Chain Guide



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- **Positive, efficient valve control**
- **Saves money on fuel and steam**
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Four simple, quickly assembled parts, quickly installed — in range of 10 adjustable sizes to fit all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

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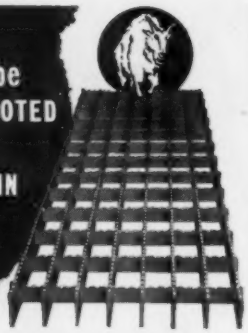

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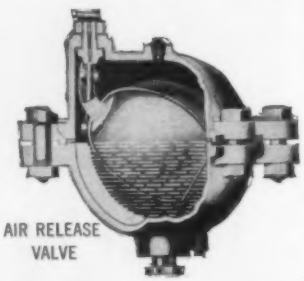
GET RID OF AIR ACCUMULATIONS IN PIPE LINES...



AIR RELEASE VALVE

a BIG trouble-saver that costs you LITTLE!

When air lodges at high spots in pipe lines, it reduces the effective area of the pipe, creates a friction head, lowers pumping capacity, and may result in serious water hammer!

Simplex Air Release Valves bring you a sure, efficient cure for these difficulties . . . venting air *automatically before it can cause damage.*

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IT'S SIMPLEX IT'S ACCURATE

Write for free bulletin to Simplex Valve & Meter Co., 6780 Upland Street, Philadelphia 42, Pa.

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More FREE BULLETINS

Begins on page 176

and complete specs. Phoenix Manufacturing Co, Joliet, Illinois.

57 **Butterfly valves,** air-operated. Twelve-page booklet containing photos, tables and complete specs. Bulletin 1701, Minneapolis-Honeywell Regulator Co, Wayne and Windrim Aves, Philadelphia 44, Pa.

WELDING

58 **Wall chart.** Colorful, informative chart on welding includes 9 data charts and 10 photos. Resistance Welding Div, Ampco Metal Inc, 1745 S 38th St, Milwaukee 46, Wis.

59 **Battery unit** for stud welding. Single-sheet specification bulletin. KSM Products Inc, 322 Woodland Ave, Merchantville, N. J.

PRIME MOVERS & ACCESSORIES

60 **Geared turbine generators.** Two-color, 24-page booklet. Photos, engineering and construction data, diagrams. Bulletin 1969, Sales Promotion Dept, Worthington Corp, Harrison, N. J.

61 **Vibration-free** installations of diesel and gas engines. Two-color, 2-page bulletin contains photos and case histories. Bulletin PS-4, The Korfund Co, Inc, 48-48E 32nd Pl, Long Island City, N. Y.

62 **Dual fuel engines.** Two-color, 36-page booklet. Photos, statistics, case histories and comments on fuel consumption. Bulletin S-500-B57, Sales Promotion Dept, Worthington Corp, Harrison, N. J.

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★ **Ion exchange booklet** explains fundamentals of industrial water treatment. Two-color, 24-page booklet illustrated with flow diagrams. ★Request direct from Rohm & Haas Co, Resinous Products Div, Washington Square, Philadelphia 5, Pa.

63 **Continuous water softener.** Describes physical characteristics, sizes and capacities. Photos and specs. Two-color, 4-page bulletin 4083, The Dorr Co, Barry Pl, Stamford, Conn.

64 **Water treatment** for cooling towers. Technical data and tables. Six-page bulletin 28X7501A, Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

MARMADUKE

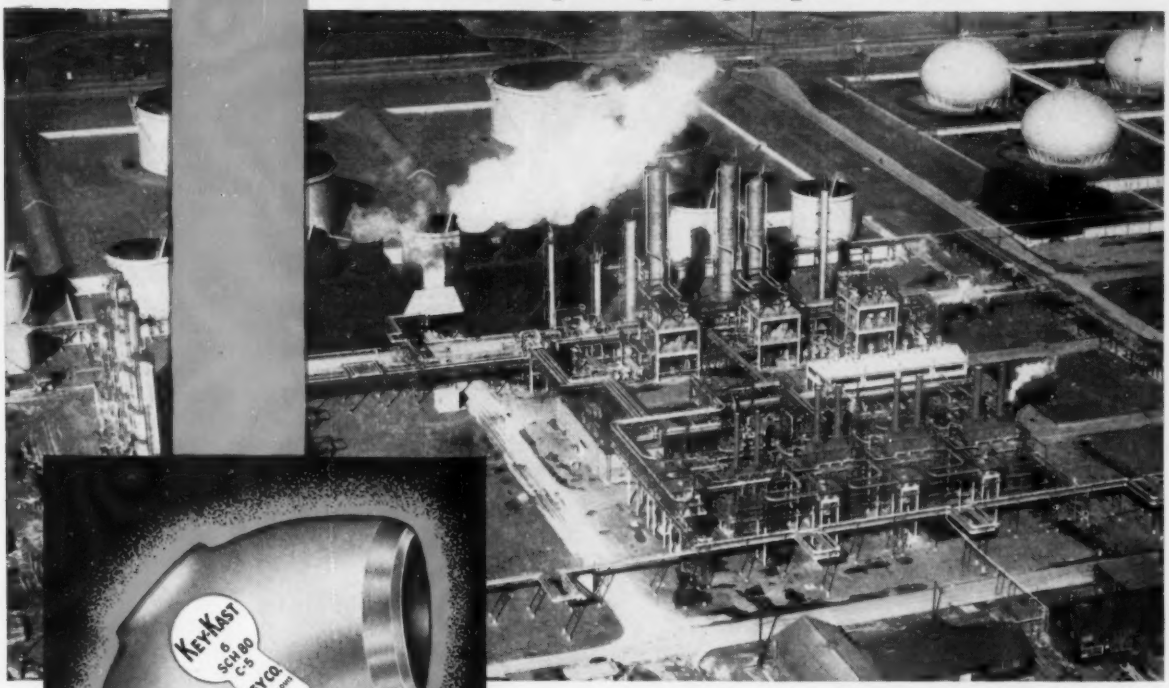
Continued from page 154

nected to a conveyor for handling icecakes and hoisting them to various levels in the storage house.

"That engine was about 200-ft from the boiler room and was connected by a 2½-in. buried steam line carrying 200 psi. When a handy man started this engine a few weeks before, for the first time that season, it hardly turned over. There could be only one answer: the line had broken or corroded somewhere between the boiler room and the engine. But that's where the problem got complicated.

"Isambard Gooch was a nephew of the original owner. When Deuterman died, he left the plant to Isambard and his large estate next to the ice house to his brother Joshua Gooch. But these two quarrelled over the inheritance and became deadly enemies. And that 200-ft

Higher Strength at Lower Cost for Alloy Piping Systems



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WELDING FITTINGS

KEY-KAST FITTINGS OFFER

- Greater wall thickness throughout—for increased structural strength
- Extra thickness in critical areas—for greater allowance against erosion
- Lower unit cost
- Materials that meet A.S.-M.E and A.S.A. Codes
- Rigid testing and inspection to meet high standards of quality

Serve NEW SUNOCO Marcus Hook Refinery

This well-ordered maze of steel piping and fractionating towers is Sun Oil Company's new petrochemical plant, located at the 1,900-acre Sunoco refinery at Marcus Hook, Pennsylvania. It produces aromatic chemicals for the synthetic rubber, plastic, detergent and other industries.

As added insurance against breakdown in the flow of these vital materials, Sun Oil Company chose sturdy, dependable KEY-KAST Welding Fittings to serve the piping system in this ultra-modern $15,000,000 plant.

WRITE TODAY for new Bulletin

KEY-KAST FITTINGS ARE AVAILABLE IN EVERY SHAPE, SIZE, AND SCHEDULE

IN LOW AND INTERMEDIATE ALLOYS AND VARIOUS STAINLESS STEELS

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Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

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Where you need

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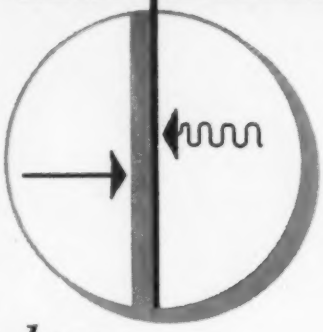
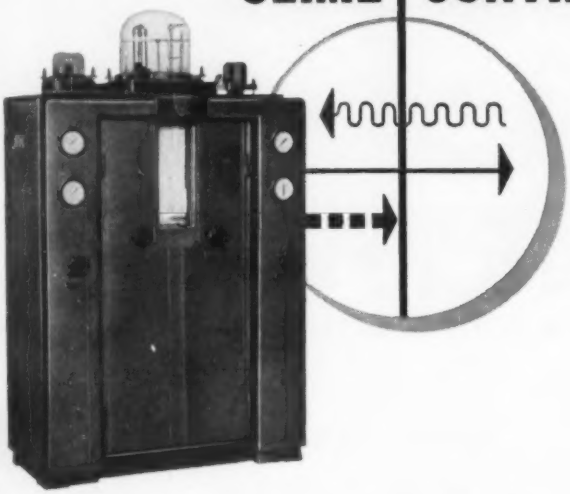


Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

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CD-39

MARMADUKE

Continued from page 244

steam line cut diagonally across Joshua's estate to the engine and storage house near the pond. When that leak was discovered, Joshua wouldn't let Isambard dig up 'his property.'

"Because the pond was caked over and ready for harvesting, the fight became a political issue and the townspeople took sides. Isambard appealed to the mayor who, in turn, appealed to Joshua, 'for the good of the community.' If that ice wasn't harvested it would hurt everyone, according to the mayor. Finally, Joshua broke down and made one concession: they could dig for the leak, but, *in one place only*. If it wasn't there, that was just 'too bad.'

"That's when Professor Pocheckoff from the local college got into the act. First, he inspected the ground over that line for surface indications. But there were none. Then he used a long homemade stethoscope to listen for escaping steam. Still no dice. He came up with various theories, but they all would be expensive and he couldn't guarantee results. Gooch couldn't take chances in not finding that leak the first time, so he called O'Houlihan. I told him if I didn't mark off the spot directly above that leak he wouldn't owe me a cent.

"When the Prof learned about the equipment I asked for, he told Gooch, and everyone else, that I was crazy. Said he'd be on hand when 'that clown arrives.' That remark got into the Rochester papers and engineers from all around heard about it.

"Isambard picked me up at the station and drove me out to the ice house. Said he had one hell of a time finding a ship's sextant and asked me why I needed a navigation instrument. I didn't answer. When we arrived at the plant, Isambard's wooden fence was lined with about 200 people, all looking over at the copper wire stretched on the well-kept lawn of Joshua Gooch. And Joshua was waiting, on his property, for the fun to begin.

"'Would you mind telling me how you expect to find the leak with all that assortment of rubbish?' sneered Prof Pocheckoff as he gave me the once-over.

"'Sure thing, Mac,' I answered. 'My method is based on Kurtz' theory of solar-hydrated ground waves.' The professor's eyes went suddenly crossed on that one so I swung into action while he meditated.

"It was a clear cold day in February and the equipment I asked for was spread on a large canvas near the boiler room. And there to help me was a young operator, Bill Arvidson. I told Bill to open the steam valve in the boiler room and make sure the engine's throttle was shut off. Then I asked him

Large Capacity
SERIES 95
PRESSURE REGULATOR

For steam, air, gas, oil, water or other fluid. Sizes ¼", ⅜", ½", ¾", 1". Outlet pressures from 2 to 30 psi; 15 to 150 psi. Easily installed—no external control lines.

Bulletin C-95 illustrates and describes new internal construction features which give higher capacity and close regulation. Write for your copy today.

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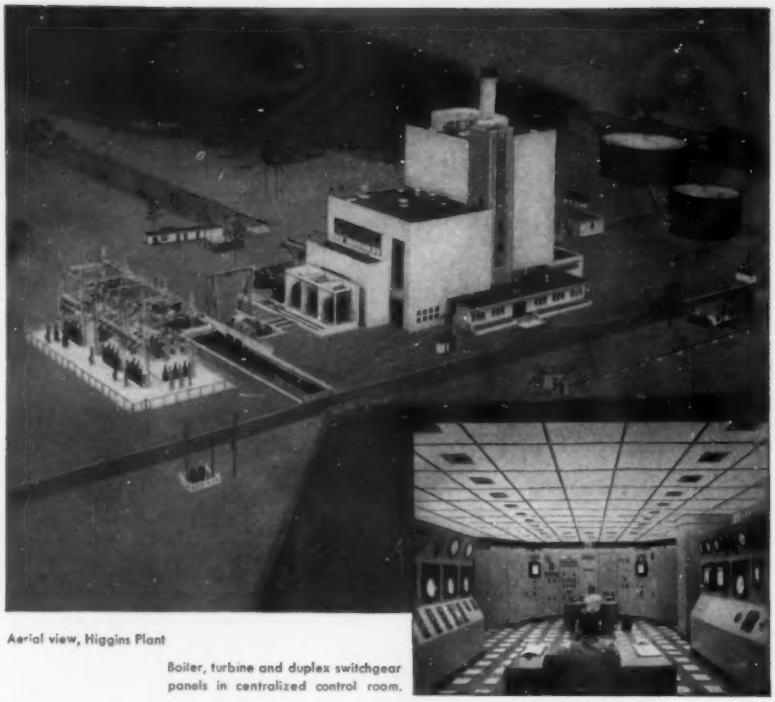
LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL



Aerial view, Higgins Plant

Boiler, turbine and duplex switchgear panels in centralized control room.

Engineering & Construction

A SINGLE RESPONSIBILITY

Higgins Plant, Booth Point, Florida, is the leading generating station of Florida Power Corporation. The first unit, of 44,000 kilowatt capacity, supplies electric power to take care of present industrial, commercial and residential load requirements.

Station design, based on unit boiler-turbine arrangement, provides for economical future expansion. Two additional units will increase station capacity to 132,000 kilowatts to meet western Florida's rapidly growing power needs.

The complete unit—designed, engineered and constructed by Kuljian under a *single* contract—was completed six months ahead of schedule, for less than estimated cost.

The **Kuljian** *Corporation*

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MARMADUKE

Continued from page 246

to get me a five-foot length of half-inch pipe.

"When Bill came back with it I handed him all the instruments. The crowd watched while I used the pipe as a tent pole under that canvas. I told Isambard and Bill to guide the forward ends of the canvas over the ground while I huddled inside the tent with the instrument and walked along the wire.

" 'I don't want the ground waves to escape between the tent's edge and the ground or my experiment'll flop,' I explained. Joshua busted out laughing and the crowd chimed in and pressed in closer along the fence.

"Inside the tent I started walking slowly along the wire. Bill and Isambard did their stuff and guided the canvas' forward edge along the ground. After the tent had moved forward very slowly for about a hundred feet, the crowd saw it stop. Then the tent moved backward slowly for a few feet, then forward again. The spectators roared and I heard plenty of wisecracks.

"Finally, I stepped out of the tent and touched one lead of the galvanometer to the copper wire and stuck the other end into the ground. I carefully marked the zero reading in my notebook. Then after shooting the sun with the sextant, I walked a few inches forward. I shoved the pipe into the lawn at that exact point and yelled, 'Here is your leak.'

"By this time, Professor Pocheckoff was so worked up he could only point at the sextant and stutter. Isambard had a laborer jump over the fence with his shovel and start digging. By then that fence couldn't hold the crowd back. They all started jumping over and got around the digger. The wisecracks were really flying fast and thick.

"After about 15 minutes of digging a feather of steam came out of that hole. That stopped the chatter. The professor's eyes popped. 'Shut off the steam,' I told Bill, 'so this guy can keep digging.' After a few more minutes his spade struck the pipe and, as he dug the dirt away from under it, everyone tried to peek into the hole.

"The laborer found a coupling with a large hole corroded through the bottom. The soil was so sandy down there that it had absorbed that steam and condensate. Professor Pocheckoff gave one look and walked away, muttering to himself. Back in Isambard's office I collected my money and he drove me to meet the next .rain."

With that, Marmy stopped talking and turned back to the bar. His story had us all so spellbound that we remained stiff as statues and several seconds passed before we realized he had

This MARLEY Cross-Flow has no secrets from the operator . . .

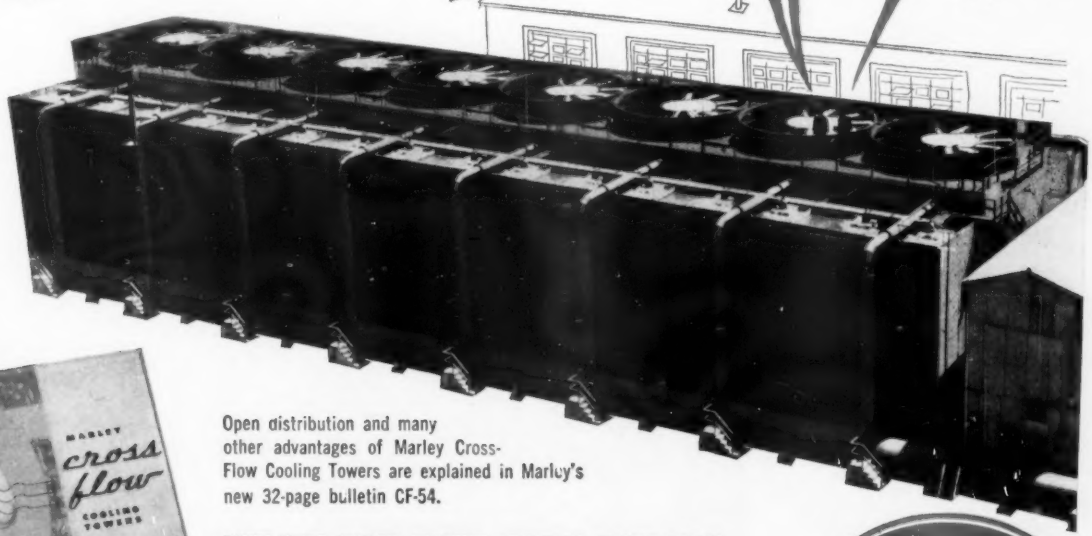
Open gravity distribution is one of the exclusive design features of Marley Cross-Flow cooling towers that makes them so "easy to live with" — and so economical to operate.

Is the water loading correct in every basin? Is the water flowing freely to every part of the tower fill? Are the basins clean? One glance and the operator of a Marley Cross-Flow has all the answers. And he takes that glance while making his inspection from a safe walkway. There is no need to subject himself to the hazards and discomfort of climbing into the tower to ascertain conditions.

If a change in water loading is desired, the valve is at hand and the variation in flow is visible. Since no pressure is required, increase or decrease in flow will not impair operating efficiency. No part of the fill will be starved; no part of the fill will be flooded.

Should a basin require cleaning, it is the work of minutes to shut down only the basin needing attention, clean it with complete safety and restore it to operation.

. . . a single glance tells you where you stand!



Open distribution and many other advantages of Marley Cross-Flow Cooling Towers are explained in Marley's new 32-page bulletin CF-54.

WRITE FOR FREE COPY TODAY!

The Marley Company

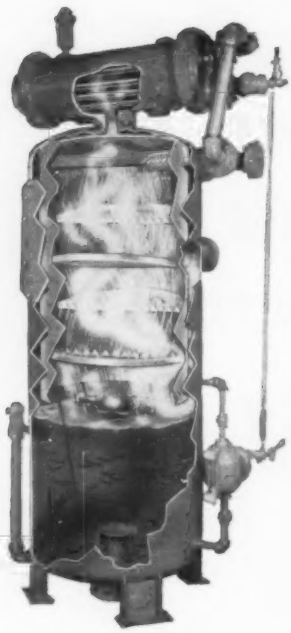
Founder-Member Cooling Tower Institute Kansas City, Missouri

MARLEY

Stop Corrosion

caused by oxygen and carbon dioxide in boilers, steam and return lines . . .

WITH NEW "SELF-CLEANING" STICKLE FEED WATER HEATER



The new Stickle Baffle Spray Type Feed Water Heater stops corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduces fuel costs and boiler strain by preheating feed water.

SELF-CLEANING There are no loose baffles or trays to remove for cleaning or repair. "Self-cleaning" action takes care of small amount of lime and other minerals which may form.

OPERATION Feed water is sprayed upward against special hood, falls in mist on top baffle. Baffles are permanently installed. Semicircular, they extend in gradual slope to straight upturned serrated edge. Water cascades over edges in series of thin streams. Steam sweeps upward, carrying with it non-condensable gases. Vent condenser prevents steam waste.

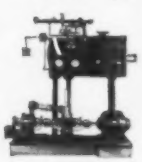
CAPACITIES Capacity range in the various models is 3,000 to 300,000 pounds of preheated feed water per hour.

This Stickle unit is the latest development in more than 50 years of building feed water heaters. It is engineered to individual specifications, and guaranteed to obtain predetermined results. *Write for new folder S-217.*

STICKLE STEAM SPECIALTIES COMPANY
2265 VALLEY AVENUE • INDIANAPOLIS 18, IND.

Open Coil Feed Water Heaters

Open Float Steam Traps



Differential Drainage and Boiler Return Systems

Regulating and Reducing Valves

MARMADUKE

Continued from page 248

finished his yarn.

"OK," yelled a crusty looking engineer from a rear table. "What in hell did you do inside that tent?"

Marmy looked slowly over his shoulder and roared, "Why, I took off my shoes and socks so that my bare feet could detect the slight temperature difference over that leak."

That brought down the ceiling with loud guffaws and laughter. When the noise stopped, another character yelled, "But why did you need that sextant and other paraphernalia?"

"Because," bellowed Marmy, raising himself to his full height, "any jackass knows that people hate to shell out for a simple idea unless you make it seem tough by putting on a medicine show."

—*SME*

More POWER NEWS

Begins on page 160

ignition temperature, water spray was the most desirable protection. "Ordinary smothering agents such as carbon dioxide and dry chemical are not suitable extinguishing mediums in this case," the Ansul report stated.

Any company or industry interested in obtaining additional information about this free fire testing service may contact Mr Guise at Ansul Chemical Co, Marinette, Wisconsin.

General Electric Co has announced it will build one of the largest mobile transformers ever to be used for highway use. The unit, ordered by the Louisville Gas and Electric Co, will be used to replace equipment on the line during emergency periods or for general maintenance. It will be mounted on a 75-ton low-bed semi-trailer and will be a forced-oil cooled, three-phase unit rated 25,000 kva, 60 cycles. The four windings with voltage ratings of 138,000 GrdY, 69,000 GrdY, 37,000 GrdY and 14,000 volts, will require 13 bushings. Differential current transformers mounted on each bushing will permit protection for the transformer in case of faults. Power for the pumps and fans of the cooling equipment will be provided by a control power transformer within the main unit.

Eugene, Oregon Water and Electric Board's proposal to finance power facilities of Cougar Dam on the McKenzie River within the concept of local partnership with the federal government has the personal indorsement of President Eisenhower. The President's reference to the plan as "perfect example" of the partnership policy followed filing of bills in both houses to permit the municipality to put up $10.5-million cost of the project authorized for flood control, but without power facilities.

(*More Power News on page* 252)

A. P. GREEN

Plastic and Castable Monolithic Linings Give Higher Operating Efficiency . . . Lower Maintenance Costs in Watertube Boilers

Monolithic refractory linings, properly installed, give better combustion efficiency and longer service life than any other type lining.

During operation, the sections of a furnace are subjected to different conditions. Each A. P. Green product has been developed to meet the service requirements of the zone for which it is specified. A. P. Green plastic and castable furnace linings installed under the supervision of trained personnel give you the full benefit of monolithic construction, plus the advantages of "zone-rated" materials.

SUPER HYBOND is a special super duty plastic that develops high strength throughout its entire thickness . . . regardless of furnace operating temperature. It is ideal for use in spreader stoker arches and piers, behind waterwall tubes, and as a seal around tubes where they pass through the wall.

SUPER-PLASTIC . . . a super duty plastic designed for use where operating conditions are unusually severe. Gives excellent service in complete monolithic linings, side walls in furnace area, flat suspended arches and spreader stoker arches. Patching and repairing firebrick or plastic linings with SUPER-PLASTIC results in longer, more efficient service.

PLASTIC QUIK-PAK . . . a high duty plastic refractory which combines refractoriness, low shrinkage and hot load bearing strength. It is used in constructing monolithic side walls and in patching those portions of watertube boiler linings which do not require super duty plastic.

KAST-SET is a high quality refractory castable which develops a strong hydraulic bond without application of heat. Recommended for convection sections of watertube boilers, baffles, waterwall backing, linings for stacks, breechings, flues, and ducts.

KAST-O-LITE is a lightweight, insulating castable refractory for temperatures up to 2500° F. Used for monolithic linings in convection sections of boilers. Reduces heat loss. Insures closer temperature distribution and control.

For properly engineered monolithic linings call your A. P. Green distributor —he's listed in the yellow pages of your telephone directory.

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Toronto 15, Ontario

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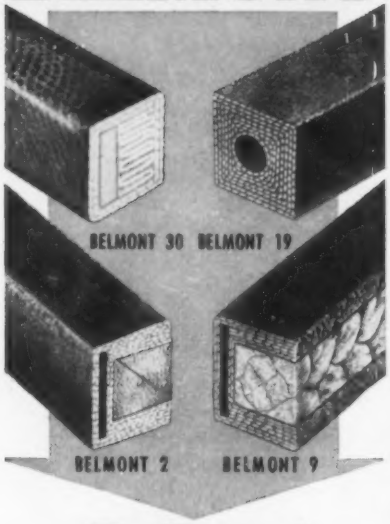

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Any BELMONT Packing, properly fitted, outlives its original cost value many times over because of its longer lasting endurance and reliability.

Where GOOD LONG-LIVING QUALITY is a *MUST* – THERE IS A BELMONT PACKING OR GASKET TO FIT YOUR *EVERY* NEED! Whether for minimum hot or cold oil penetration and saturation . . . For maximum resistance against extreme temperature changes . . . For a higher flexibility and resiliency on high pressure steam rods and hammers, expansion joints, air rods . . . For more continuous free motion of shafts working against steam, hot or cold water, oil, acids . . . In fact, for *all* types of Packing services, you'll always find a BELMONT standard or specially constructed BELMONT PACKING to answer your problem.

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Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
There's a Belmont Packing for every service

More POWER NEWS

Begins on page 160

Coming Events

June 13-18—American Society for Testing Materials, annual meeting, Sherman and Morrison Hotels, Chicago, Ill. For details write ASTM, 1916 Race St, Philadelphia 3, Pennsylvania.

June 14-17—American Society of Mechanical Engineers, annual conference and technical exhibit of the Oil and Gas Power Division. Muehlbach Hotel, Kansas City, Mo. For details write ASME, 29 W 39th St, New York 18, N. Y.

June 21-25—American Institute of Electrical Engineers, Summer and Pacific general meeting. Biltmore Hotel, Los Angeles, Calif. For details write AIEE, 33 W 39th St, New York 18, N. Y.

June 28-30—American Society of Heating and Ventilating Engineers, 60th semi-annual meeting. New Ocean House, Swampscott, Mass. For details write ASHVE, 62 Worth St, New York 13, N. Y.

July 13-15—Plant Maintenance Show and **Plant Maintenance Conference,** Pan-Pacific Auditorium, Los Angeles, Calif. For details write Clapp & Poliak Inc, 341 Madison Ave, New York, N. Y.

Sept 1-16—International Electrotechnical Commission, golden jubilee meeting at University of Pennsylvania, Philadelphia. For details write U. S. National Committee, American Standards Association, 70 E 45th St, New York 17, N. Y.

Sept 27-29—American Institute of Electrical Engineers, petroleum conference, Mayo Hotel, Tulsa, Okla. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Sweden's experimental reactor to be ready for use this year

► SWEDEN'S FIRST EXPERIMENTAL reactor will be ready for use by mid-1954, and a second reactor is planned under a new 5-year plan approved by the Swedish parliament.

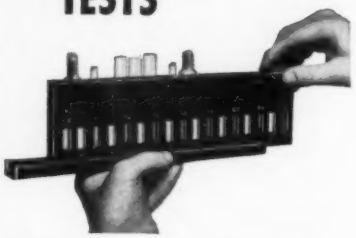
The reactor, under construction in Stockholm, will use three tons of natural uranium and six tons of heavy water which will be air cooled in a heat exchanger. The reactor, rated 100 kw, will be used for production of certain radioactive isotopes that cannot be purchased outside Sweden.

The second reactor, to be built outside Stockholm, is to be rated 10,000 kw and will have a substantial capacity for production of radioactive isotopes. With the planned reactor, large enough quantities of plutonium can be obtained to make possible the later building of concentrated reactors with plutonium for the study of breeding problems.

(*More Power News on page 258*)

"couldn't do without my

TAYLOR COMPARATOR for BOILER WATER pH, PHOSPHATE TESTS"



That's what power plant engineers say in plants all over the country . . . because Taylor Comparators give you fast, easy determination of boiler water pH and phosphate, as well as complete water analysis. And you can make these determinations right in the boiler room! No need to carry solution samples back to the lab since your Taylor Set is lightweight, small, no trouble to carry with you.

EASY TO USE

Taylor Comparators use the familiar colorimetric method of comparison, but without the need for fragile, single Nessler tubes. All color standards for a single determination are housed in a sturdy plastic slide. Many different slides may be used on the same base.

ACCURATE

There's no chance of mechanical inaccuracy because all Taylor Liquid Color Standards carry an unlimited guarantee against fading!

GET THE FULL STORY . . .

from your lab supply dealer . . . or write for free book, "Modern pH and Chlorine Control". Gives theory and application of pH and Chlorine control, illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

STOWE Stokers

they eliminate smoke and fly ash nuisance saving users the cost of installing and operating special control equipment

Assure Clean Stacks

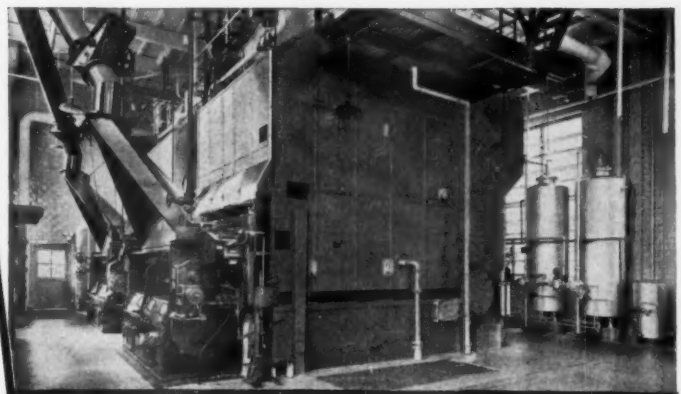
● Their even depth of fuel bed from side to side and all the way from front to rear enables Stowe Stokers to comply fully with the most rigid smoke and fly ash ordinances. They have **never** required the installation of any special control equipment.

LOW AIR PRESSURES

STOWE STOKERS don't have to blast air up through coal piled around raised tuyeres. Consequently they operate with wind-box pressures of 2/10″ to 6/10″ (1″ maximum). The coal is burned **in the fuel bed** — not in suspension — eliminating fly ash problems and assuring clean stacks **at all ratings.**

PROVEN ADVANTAGES

CLEAN STACKS is only one of the advantages Stowe Stokers can give you. Extremely high rates of burning per square foot of grate area; rapid response to fluctuating loads; the ability to burn any grade of coal; are some of the others. Why not get full details? Write for Bul. No. 501. It tells **what** Stowe Stokers do — and **why** they are able to do it.

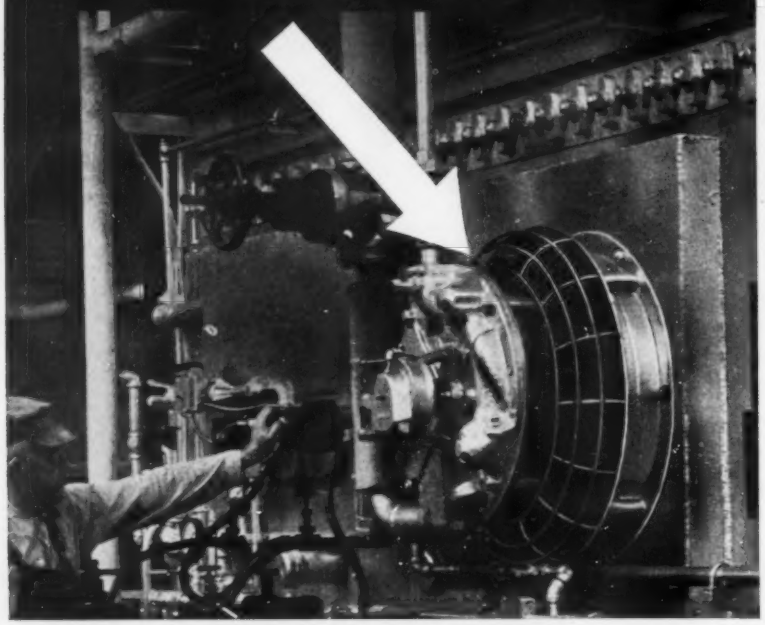


Above: Two Stowe Stokers Under 35,000 Lbs./Hr. Boilers in Food Plant.
Below: Stowe Stokers Under Four 90,000 Lbs./Hr. Boilers (Continuous Pattern).

STOWE Stokers

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio
.... *Division of* PETTIBONE MULLIKEN CORP...

Only a WING Axial Flow Turbine Blower would permit such a compact installation



THIS neat, compact forced draft installation shows how the WING Axial Flow Turbine Blower can save thousands of dollars in installation costs by eliminating the duct work and excavation costs attendant on the use of other types of blowers. This compact, quiet, low-speed blower delivers 11,300 CFM at 3" static pressure to the 40,000 lb. per hr. B & W oil-fired boiler at the Chicago plant of Southern Cotton Oil Co., makers of the well-known Wesson Oil. This is the third Wing blower at the Chicago plant, the tenth in all Southern Cotton Oil plants, the first having been installed in 1916.

L. J. Wing Mfg. Co.

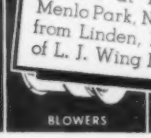
50 Vreeland Mills Road, Linden, N. J.
Factories at Linden, N.J. and Montreal, Can.

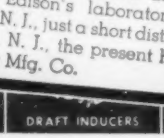
OUR 75TH YEAR 1879

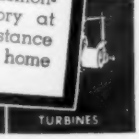
Wing

SEVENTY-FIVE YEARS AGO

In 1879, the year the L. J. Wing Mfg. Co. was founded, Thomas A. Edison perfected the first practical incandescent electric lamp. The scene above shows the successful demonstration at Edison's laboratory at Menlo Park, N. J., just a short distance from Linden, N. J., the present home of L. J. Wing Mfg. Co.







My Biggest Boner

► ONE DAY DURING my apprenticeship our foreman told me to change the seats of an 8-in. gate valve in our 200-psi steam main. Anxious to get home after finishing the job, I took the precaution of closing the main stop in the boiler room as soon as the shift ended. Then I sat down to have lunch and read the paper while the line cooled and lost pressure.

I climbed a ladder to the valve, tested its spindle and removed all nuts from the bonnet, but found the bonnet was stuck fast to the valve body. No amount of pounding with a spanner would loosen it.

I descended the ladder to the shop and hunted for a hand sledge and cold chisel. Back at the ladder I had put my foot on the first rung when there was a clap as loud as thunder, followed by the grinding of metal and tinkle of glass. I looked up to see a cloud of steam shooting skyward from the valve body. Beyond the valve I saw a patch of blue sky.

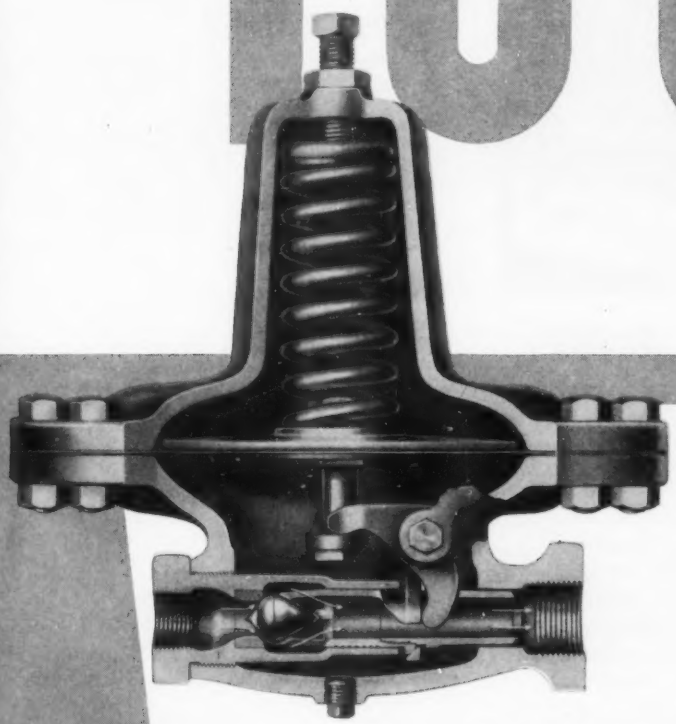
Later I learned that although I shut off the line correctly, I forgot to vent it. The line didn't cool enough to reduce the pressure. Luckily I wasn't in the way when valve body and bonnet parted. We found the bonnet in the yard, several hundred feet from the plant.

GEORGE PEARCE
Albuquerque, N. M.

• **What is your "biggest boner"? We'll pay ten dollars for each one we publish.**

Stanford Research Institute has formed a heat and mechanics section in its physics department. J Kenneth Salisbury, former manager of thermal power systems division of GE, will head up this new section that will undertake research in applied mechanics, combustion, heat transfer, thermodynamics and allied fields.

TYPE 1000 VALVE



Any product of quality should be dependable when *ordinary* products fail. Sudden pressure fluctuations, dirt, scale and viscous matter prove "fatal" to ordinary pressure reducing valves.

The CASH STANDARD TYPE 1000 VALVE however, is designed to operate with complete dependability under the most difficult and unusual circumstances. Many of these units have been in service over 10 years and have never been taken "out of the line."

Truly an *EXTRAORDINARY* achievement of quality and design excellence.

INSTALL CASH STANDARD "TYPE 1000" VALVES

CASH STANDARD **DECATUR, ILLINOIS**

A. W. CASH COMPANY

acids . . . gases . . . hot liquids . . .
SOLVE YOUR SPECIAL PACKING PROBLEMS..

for CORROSION-FREE PACKING SERVICE IN PUMPS AND VALVES....

You can effectively handle any corrosive liquid or gas by repacking your valves and pumps with "John Crane" Chemlon "C-V" Rings. Molded from the remarkable material, Teflon, "John Crane" Chemlon "C-V" Rings are impervious to almost every known chemical substance. They withstand extreme temperatures from −94° to +482°F—have extremely low friction coefficient. "Breakout" friction is only slightly higher than that of running friction. Special cross sectional design affords positive sealing at practically finger-tight gland pressure.

To bring you all the important advantages of Teflon for your particular sealing problem or application, "John Crane" has developed a complete line of Chemlon "C-V" Rings and male and female adapters. If you have special requirements, additional sizes can be molded to fit your stuffing box dimensions.

"John Crane's" illustrated booklet "The Best in Teflon" contains extensive information on a wide variety of Chemlon Products. Send for your free copy. Crane Packing Co., 1830 Cuyler Ave., Chicago 13, Ill.
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

*DuPont's trademark

JOHN CRANE CRANE PACKING COMPANY

APPOINTMENTS

Corporation Executive Changes

Caterpillar Tractor Co: Louis B Neumiller, chairman of the board; Harmon S Eberhard, president. **The Babcock & Wilcox Co:** W J Thomas, vice-president. **Electric Service Engineering Co:** B F Pfeifer, executive vice-president. **Texas Eastern Transmission Corp:** J B Saunders Jr, vice-president. **General Cable Corp:** Irving T Bennett, chairman of the board.

Operations Executive Changes

General Electric Co, Meter and Instrument Dept, Warren C Hutchins, manager of product planning. **Borg-Warner Corp,** Detroit Gear Div, T J Ault, president and general manager. **Allis-Chalmers Manufacturing Co:** J W McMullen, vice-president in charge of transformer and switchgear equipment.

Engineer Changes

Westinghouse Electric Corp: C B Campbell, chief engineer for S Philadelphia, Pa. steam div. **Durabla Manufacturing Co,** Raymond H Blackford, vice-president in charge of engineering. **Allis-Chalmers Manufacturing Co:** H D Emmert, engineer in charge of development of steam turbine section. **Western Precipitation Corp:** Richard G Gaw, liaison engineer for steel industry applications.

New Sales Managers

Gustin-Bacon Manufacturing Co: G P Oldham. **Eutectic Welding Alloys Corp:** L D Richardson. **General Dynamics Corp,** Electro Dynamic Motor and Generator Div: Edwin R Campbell, Southern manager. **International Rectifier Corp:** Allen S Nelson, distributor sales. **J F Pritchard & Co of California:** Chester F Shortal, newly-opened Kansas City office; W R Roeyer, cooling tower and heat exchanger sales. **Federal Electric Products Co,** Pacific Electric Manufacturing Corp: Don L Orton, north central region.

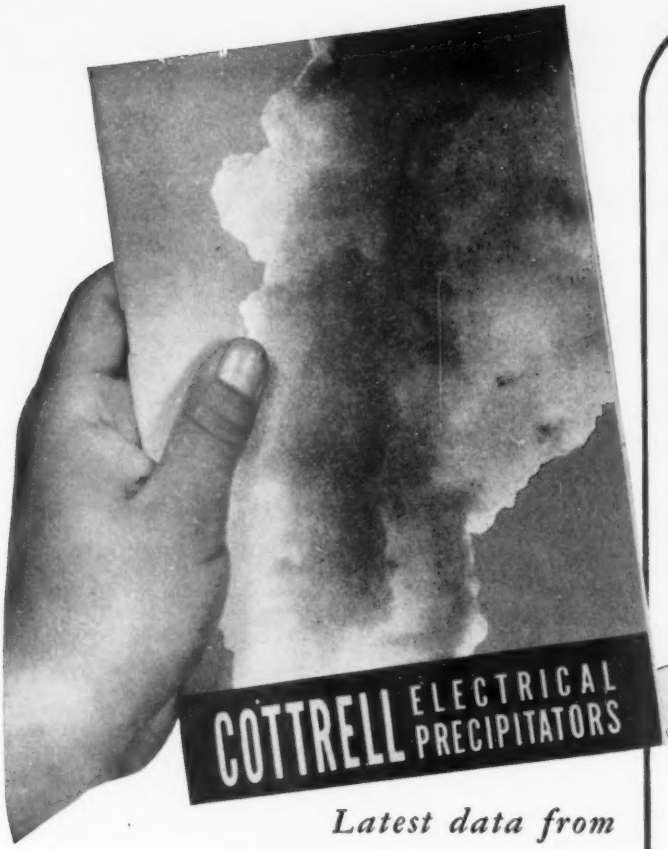
New Distributors

For **General Electric Co,** Carboloy Dept: Alden Supply Co Inc, Philadelphia, Pa. For **Morse Chain Co:** Service Power Transmission Co, 13-01 5th St, Fair Lawn, N. J. and Navarro Supply Co, Pecos, Texas.

New Representatives

For **United Conveyor Corp:** Reed & King Inc, Foshay Tower, Minneapolis 2, Minn. and Hesler Co, 1233 Dierks Building, Kansas City 6, Mo. For **Black, Sivalls & Bryson Inc:** Fluid Controls Co Inc, 5150 Ridge Ave, Philadelphia 28, Pa. and Berry Ervin Engineering Co, 732 Builders' Exchange Building, Minneapolis 2, Minn. For **Clark Equipment Co:** Thompson and Johnson Equipment Co Inc, 1898 Erie Boulevard, E Syracuse, N. Y.

(*Continued on page* 258)

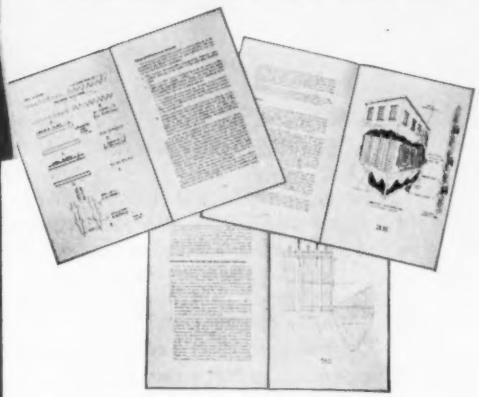


40 PAGES of helpful information

on Recovering Dusts, Fly Ash, Mists, Fumes and other Suspensions from Gases.

This booklet summarizes

the important points design and plant engineers should know about Cottrell Precipitators . . .



- Basic types of Cottrell equipment.
- Principal elements in a Cottrell unit.
- Data on Mechanical and Electronic Rectifiers.
- Various types of Collecting Electrodes (rod curtains, corrugated plates, pocket electrodes, etc.).
- Typical ways of removing collected material.
- Various Shell Constructions (steel, concrete, brick, etc.).
- The effect of various factors on efficiency and performance.
- Data on CMP (Combination Multiclone-Precipitator) Units.

. . . and many other helpful facts on Cottrell design and operation.

Latest data from Western Precipitation on Cottrell Recovery Equipment

Do you have operations in your plant where gas-laden suspensions, wet or dry, are a problem? Such suspensions may be dropping on surrounding property, causing nuisance difficulties. Or perhaps important values are being lost in stack gases that can be profitably recovered. Whatever the nature of your recovery requirements, you will find this 40-page Cottrell booklet of great help. It contains up-to-date data on the latest advancements in the electrical precipitation field – prepared by the organization that pioneered the commercial application of Cottrell Electrical Precipitators almost a half century ago and has consistently led in new Cottrell developments.

A copy of this data-packed booklet will be sent free to engineers and other executives interested in recovery processes. Send your request to our nearest office.

For nearly 50 years Western Precipitation has carried on a continuous research and development program on Cottrell Electrical Precipitators, Multiclone Mechanical Collectors and other types of recovery equipment. We are not affiliated with any other company in the electrical precipitation field except our wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. We are equipped to serve you anywhere in the United States, Canada, and throughout the world!

WESTERN Precipitation CORPORATION

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

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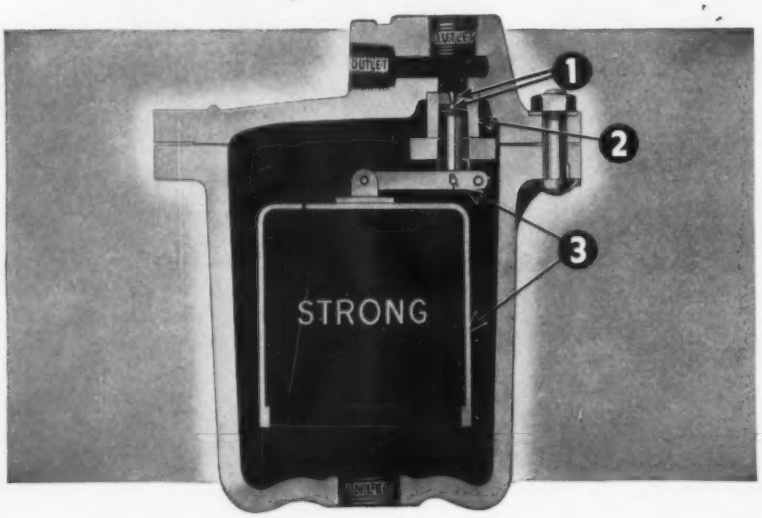
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-H describes inverted, open bucket and other types of STRONG traps. Write today.

*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve | 70 Series Trap | Strainer

STRONG

More APPOINTMENTS

Begins on page 256

Recent Moves

Graybar Electric Co: new branch at 761 Planters St, Rocky Mount, N. C.; Norfolk, Va. house now at 35th St and Hampton Blvd. **Bailey Meter Co:** Seattle district office now at 200 Broadway, Seattle 22, Wash. **Cyrus Shank Co:** now at 4646 W 12th Pl, Chicago 50, Ill. **Worthington Corp:** New York executive headquarters and district sales office now at 99 Park Ave, New York, N. Y. **Tempil Corp:** all facilities now consolidated at 132 W 22nd St, New York, N. Y.

Recent Purchases

Ladish Co: capital stock of Tri-Clover Machine Co. **Thor Power Tool Co:** entire facilities of Speedway Manufacturing Co.

More POWER NEWS

Begins on page 160

General Electric ships record-size stator to Sao Paulo

LARGEST STATOR ever shipped from the United States to South America will make up part of a 100,000-kw electric generating unit in Sao Paulo, Brazil. This 130-ton stator is the first of two destined for a $32-million plant being built by Stone & Webster Engrg Corp for Sao Paulo Light & Power Co, Ltd. When completed, this 200,000-kw plant will be the largest in Brazil.

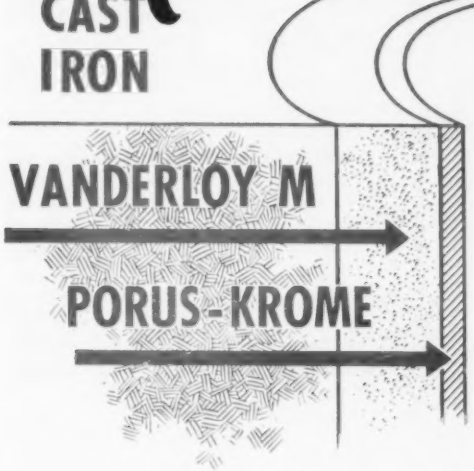
Because the route from the sea to Sao Paulo included difficult tunnels and bridges, Stone and Webster found it necessary to first ship a template duplicating the stator's overall size. Power from the new station will supply Sao Paulo and, with adjustments, part of Rio de Janeiro.

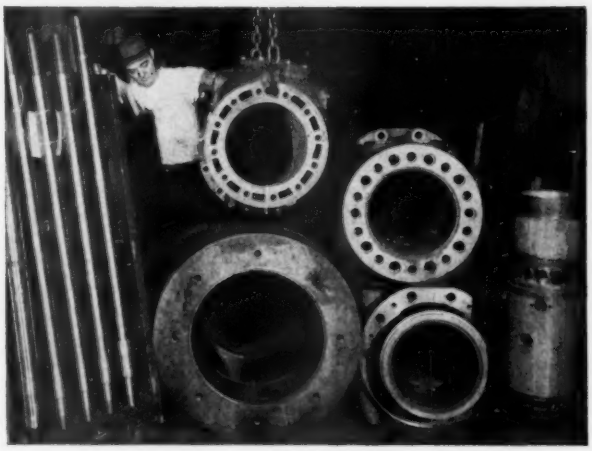
Atomic energy catalog, the first listing of its type in the nuclear field, has been released by North American Aviation. The company offers to design and build nuclear machines suitable for broad research in industry, medicine, and academic study—subject to approval by Atomic Energy Commission. The catalog, *Nuclear Reactors for Science and Industry,* describes three basic reactors: the solution, pool and homogenous-graphite types.

Applications of high-temperature ceramics will be the topic of a special summer course offered by the Massachusetts Institute of Technology from July 19-30. Recent developments in techniques will be stressed. The program is offered because of increased demands for ceramic materials for use at elevated temperatures for applications in nuclear energy, rockets, gas turbines and metallurgical and chemical processes at high temperature.

(*More Power News on page* 260)

Reverse the Wear...





VAN DER HORST

* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

U. S. PATENTS
2,048,578, 2,314,604 and 2,412,698

Why bother to have your liners oversized? Reverse the effects of wear — have your liners Van der Horst processed!

With VANDERLOY M we can plate back any liner you have to original size — and with PORUS-KROME* we can keep it that way.

A PORUS-KROME liner outwears as many as four unprocessed liners. Meantime, it uses less lube and fuel oil, delivers more power and is much easier on rings.

When such liners finally need replacing, simply slip in another set of Van der Horst Re-STANDARD-Sized liners — and send the worn ones back to us for renewal again.

Even liners you'd normally scrap are restored to original dimensions and each renewal pays pays for itself — several times over.

Of course the real profit comes when you eliminate the cost of stocking oversize parts — simply by having Van der Horst "reverse the wear" on all your liners. Let us show you how much can be saved by making this your standard practice. W52-3D

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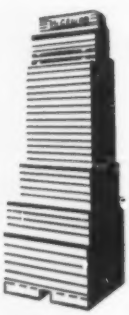

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More POWER NEWS

Begins on page 160

Space heater generates own thermoelectric power

► A SPACE HEATER that generates its own thermoelectric power for forcing hot air into circulation over the room has been developed by Frederick J Bordt Jr, associate professor of mechanical engineering at Rensselaer Polytechnic Institute.

Patented thermo-piles, built into the walls of the heater's combustion chamber, develop power sufficient to operate four small fans. These suck cold air from low levels, bring it into close contact with the exhaust tube of the combustion chamber, then discharge it at high velocity from the top. As a result of this high velocity discharge, the heater can blanket walls and ceiling with a thick layer of warm air.

The pilot model, with a combustion chamber about 10 in. wide and 12 in. high, employed gasoline as fuel, but any liquid fuel such as kerosene or jet oil can be used. The long heat exchanger, resting on top of the combustion chamber, brings the overall unit to normal ceiling height.

Built into the walls of the combustion chamber are 2400 interconnected thermo-couples, each consisting of two small metal pins about the length of an ordinary kitchen match and about half that diameter. These pins are set in horizontal rows, spaced at ¼-in. intervals and arranged in 4x7-in. panels. There are eight of these panels to develop the ten watts required for the operation of the four fans.

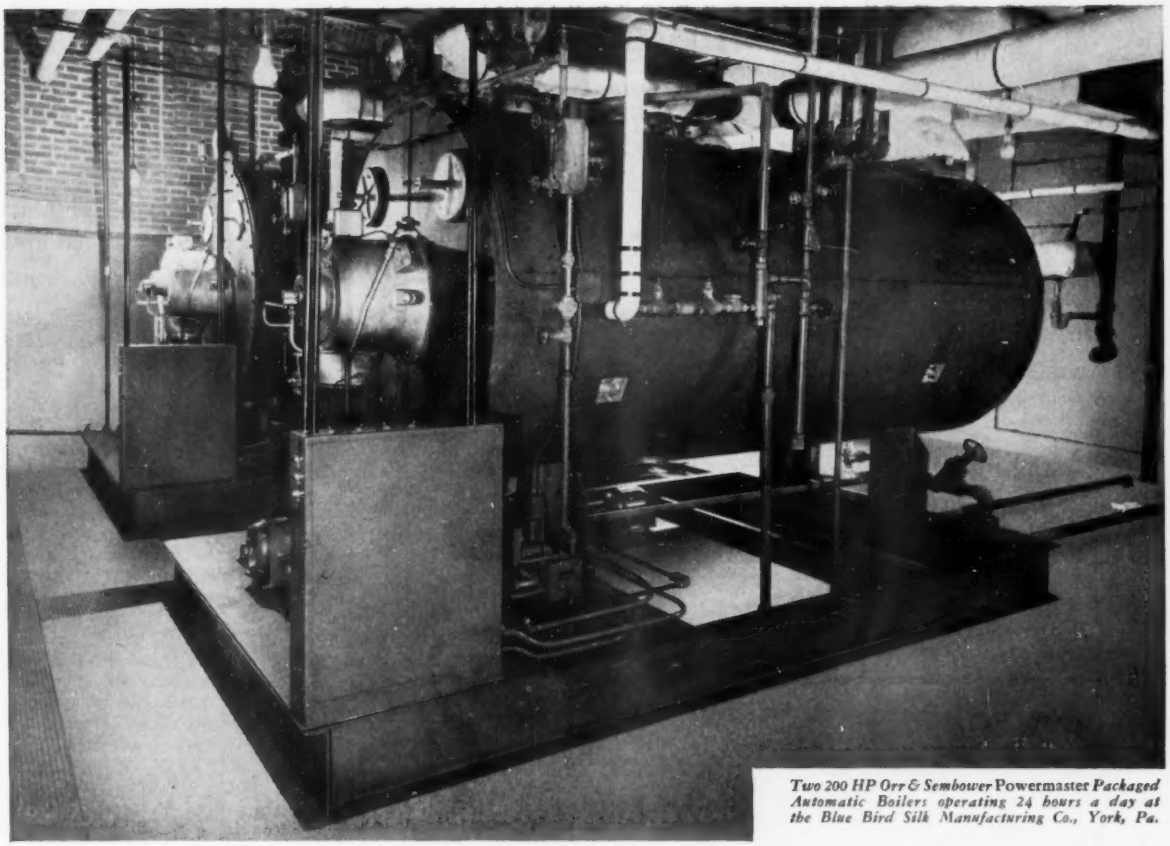
Each pin extends a half inch into the combustion chamber, runs through the half-inch ceramic insulating wall and extends three-fourths of an inch into the outside air. The hot ends of the pins are stainless steel, the cold ends copper. Embedded in the ceramic wall are connecting wires of chromel that accumulate the current and feed it to a trunk line serving the fan motors.

Quebec Hydro Electric Commission has placed an order for four hydraulic turbines, having what is believed to be the largest individual electric power output of any turbines of their kind, with English Electric Co of Canada Ltd. These units are for the ommission's Lac Casse (Bersimis) development on the St Lawrence River.

National Cylinder Gas Co will soon begin construction of a $3½-million plant for manufacture and distribution of liquid oxygen. The one-story structure will be situated on an 8-acre tract on the south side of Chicago.

(*More Power News on page 262*)

IN TEXTILE MILLS...



Two 200 HP Orr & Sembower Powermaster *Packaged Automatic Boilers operating 24 hours a day at the Blue Bird Silk Manufacturing Co., York, Pa.*

Powermaster® Performance Pays Off

STEAM COSTS DOWN 20%—negligible maintenance. That's the two-year performance record of these two *Powermaster* Packaged Automatic Boilers operating round-the-clock at the Blue Bird Silk Manufacturing Company, York, Pa.

In addition to the cost-saving advantages, these units provide dryer, higher quality steam for processing and heating than the coal-fired boiler they replaced. Burning No. 6 Bunker C oil, they produce 13,800 pounds of steam per hour. And *Powermaster's* Voriflow burner design assures top straight line efficiency when operating between 30% and 100% of capacity.

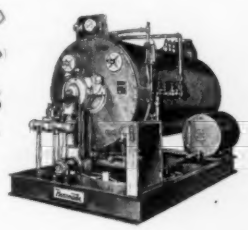
Check these reasons why *Powermaster* is today's best buy for textile mills, schools, hospitals, industrial plants and all types of buildings: Cost-saving installation, space-saving compactness, dependability, fast steaming, hospital-clean operation, maintenance-saving accessibility, fully automatic operating and safety controls and smokeless combustion.

Find out why satisfied users all over America are saying, "Steam costs go down where *Powermasters* go in". Send for latest descriptive bulletin.

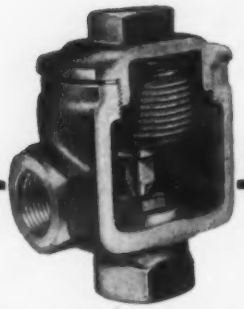
O&S *Powermaster*®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC. • Established 1885 • **Morgantown Road, Reading, Penna.**



for total heat of steam at pressure applied

use **STERLING**

THERMOSTATIC TRAPS

Large capacity—Freeze proof—bronze body—Stainless steel valve stem and seat.

Capacity 1900—11,650 lbs per hr. Pressures—5-200 psi.

Multiple trapping with Sterling will save you money.

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110 Business St., Hyde Park 36
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"The MARMADUKE STORY"

If you like those lusty Marmaduke stories in POWER, you'll want this collection. 21 of Marmy's best yarns, bound in handsome varnished cover — and only $1.00. Write to

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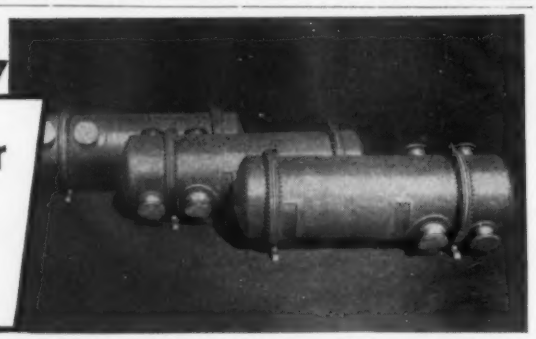

Three 54" O D x 10' 0" Heat Exchangers, with aluminum shells, tubes, tube sheets and bonnets—products of Downingtown craftsmanship.

Heat transfer equipment designed and built by Downingtown Iron Works will do a specific heating or cooling job in your plant—and do it efficiently.

Downingtown engineers are thoroughly experienced in designing custom-built heat exchangers for all sorts of chemical and petroleum applications . . . have accumulated a wealth of heat transfer data which can help solve your specific problems.

Downingtown is skilled in fabricating various grades of carbon steel, stainless steel, stainless and nickel alloy clad steels, nickel, nickel alloy, aluminum, copper alloy and Ampco 8. Built to ASME requirements where necessary. Special welding techniques developed by Downingtown, and approved by ASME Code Inspection Agencies, assure welds that are unusually sound and neat. *Send for our bulletin on heat exchanger design.*

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CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

More POWER NEWS

Begins on page 160

Canada's water-power resources are now shown as totalling more than 29-million hp under conditions of low-stream flow and of nearly 51-million hp at average flow; the latter figure represents a feasible turbine installation of nearly 66-million hp. Total turbine installation at end of 1953 is placed at 14,929,074 hp; this indicates an available resource development of less than 23%.

During last year, hydro construction was very active: 638,012 hp of new capacity went into operation and progress on other new developments was good. Ninety percent of hydraulic plants serve as central-electric stations and, in 1953, production reached a new high. Pulp-and-paper and mineral industries are the more important consumers of hydraulic and hydro power. Installed capacity of water power plants in Canada now equals 1010 hp per thousand persons.

Yutaka Kubota, Japanese power station specialist who built the famed Suiho Dam and generation station on the Yalu River recently completed preliminary survey of the 25,000-kw Leikow hydro station for the government of Burma. Kubota, or other Japanese engineers, will supervise Leikow construction at an estimated fee of $860,000. Equipment for the projects will be purchased through international tender.

Third hydro plant on Southern California's All-American Canal has gone into service. Built by Imperial Irrigation District at a cost of $2.5-million, this station is the last major project to be completed under a $12.5-million development project approved in 1948.

ASEA Company of Vasteras, Sweden's leading manufacturer of hydro-electric equipment, has received an order for three 23,000-kva generators for a new power plant at Atiamuri, New Zealand. Larger generators are being made for shipment to Spain, Canada and Egypt. ASEA has also received orders from the United States and Canada for mining hoists, an old specialty of the company.

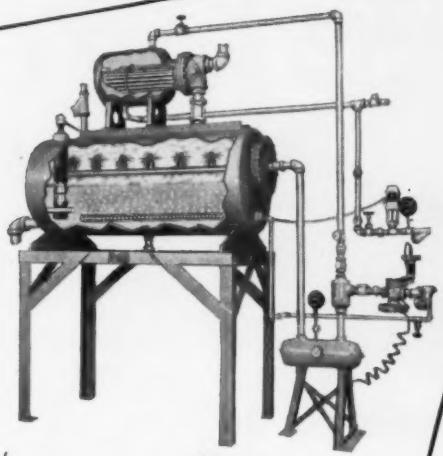
British Columbia Electric has awarded British Insulated Callenders Cables Ltd a contract to build a 132-kv, 120,000 kw submarine power cable from the mainland to Vancouver Island. Successful bid was just over $3-million to manufacture, deliver, install and test the four 19-mile cables in the circuit. This $5-million project, designed to end the danger of Vancouver's running short of hydro energy, is scheduled for completion in mid-1956.

Fuston & Hornsby, English engineering concern, has secured a $1.75-million contract to supply eight gas turbines for London County Council's northern outfall purification plant at Beckton, Essex. This will be the world's first sewage disposal works to be powered entirely by this modern type prime mover. All turbines will use sewage gas as fuel to make them self-supporting in this respect.

(*More Power News on page* 264)

A FRESH LOOK INTO *Deaeration!*

SCHAUB ZERO-OXYGEN *Deaerators*



ENTIRELY NEW

in operating principle

in mechanical design

in the advantages they offer

"Newness" for its own sake is no advantage in a deaerator. But when new thinking achieves improved performance not possible with conventional designs, it's worth looking into!

The Schaub Zero-Oxygen Deaerator differs from all others in that it provides *external* pre-heating to a temperature *above* boiling point, with over-atmospheric pressure held only up to the internal sprayer manifold. The storage receiver itself is *fully vented* and operates at constant, safe atmospheric pressure.

This simple but basic difference opens the way to a whole series of better performance characteristics, including:

LOW OPERATING COSTS
LOW MAINTENANCE COSTS
COMPLETE OXYGEN REMOVAL—(to .005 cc/liter)
COMPLETE SAFETY
WIDE RANGE FOR LOAD VARIATIONS
SIMPLER DESIGN AND OPERATION

The "hows" and "whys" of Schaub Zero-Oxygen Deaerators make an important story for any engineer or operating man concerned with boiler feedwater deaeration. Mail the coupon and we'll send it to you.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Boulevard • Chicago 23, Illinois

MAIL THE COUPON FOR BULLETIN 575

Why a deaerating system? How can it save you money and trouble? What makes a good system? How to get maximum benefits at lowest cost? What are some of the engineering factors involved?

These and many other questions are answered in Schaub Bulletin 575, just off the press. It's a valuable contribution to boiler deaeration theory and practice.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Boulevard Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 575 on Boiler Feedwater Deaeration.

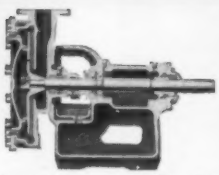
NAME.....

COMPANY.....

ADDRESS.....

CITY..... ZONE.... STATE.....

This Goulds 1½" Fig. 3705 stainless steel pump handles alkaline boiler feed water to storage heater in The Ruberoid Co. plant. It has a capacity of 125 GPM at a head of 75 ft.



Cross-section of Goulds Fig. 3705 stainless steel pump, showing special design features. Capacities up to 600 GPM. Heads up to 160 ft. Send for Bulletin 725.3.

No wear in 3 years

of pumping high-alkaline boiler feed water

Treatment of boiler feed make-up water with hot caustic phosphate in The Ruberoid Co. plant at Gloucester City, N. J., results in high alkalinity—the pH ranges between 10 and 11.

The problem of handling that severely corrosive water has been solved with a Goulds Fig. 3705 stainless steel centrifugal pump. Installed more than 3 years ago, this pump has been in continual service 24 hours a day, except during periodic inspections. There still are no signs of wear on its impeller or other internal parts.

Goulds Fig. 3705 stainless steel pumps are in service under corrosive conditions in a wide variety of industrial applications. They are designed to reduce maintenance problems. Since the stuffing box is on the suction side, packing is subjected to suction pressure only. This virtually eliminates leakage. You can clean, or remove and replace, the impeller without disturbing piping. The clearance between impeller vanes and casing is easily adjusted to compensate for wear. For additional information about Goulds Fig. 3705 stainless steel pumps, send for Bulletin 725.3.

There are Goulds pumps to fill virtually every liquid-handling requirement. And Goulds engineers have a background of 104 years of pump manufacturing and installation experience. They'll be glad to help you with your liquid-handling problems. Just write Goulds Pumps, Inc., Seneca Falls, New York.

MEMBER HYDRAULIC INSTITUTE U.S.A.

Goulds PUMPS INC.
Seneca Falls
New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA
PITTSBURGH • TULSA

More POWER NEWS

Begins on page 160

Portmar Boiler Co's entire line of steel boilers now conform to specifications of ASME's Boiler Code. Portmar, located at 193 Seventh St in Brooklyn, manufactures a complete line of oil or gas-fired heating boilers for steam and hot water heating systems.

Federal Power Commission has issued California-Oregon Power Co a 50-year license to build a $9-million hydro project on the Big Bend No. 2 site on Klamath River. This plan includes a diversion 52-ft dam, 310 ft long, and a powerhouse equipped with two 2250-kw generators.

Permatex Co has awarded Walter Kidde Constructors, Inc, a contract to design and build a new plant at Kansas City, Mo. The $500,000 project will consist of a fully air-conditioned plant of modern design with a two-level manufacturing area using gravity to minimize pumping.

The United States government has granted an $11,000,000 aid to India for development of irrigation and power projects at Pipri. This new project will bring 500,000 acres of land under irrigation and provide for the generation of 240,000 kw of power. Total United States aid to India for irrigation and power works has reached more than $21,000,000.

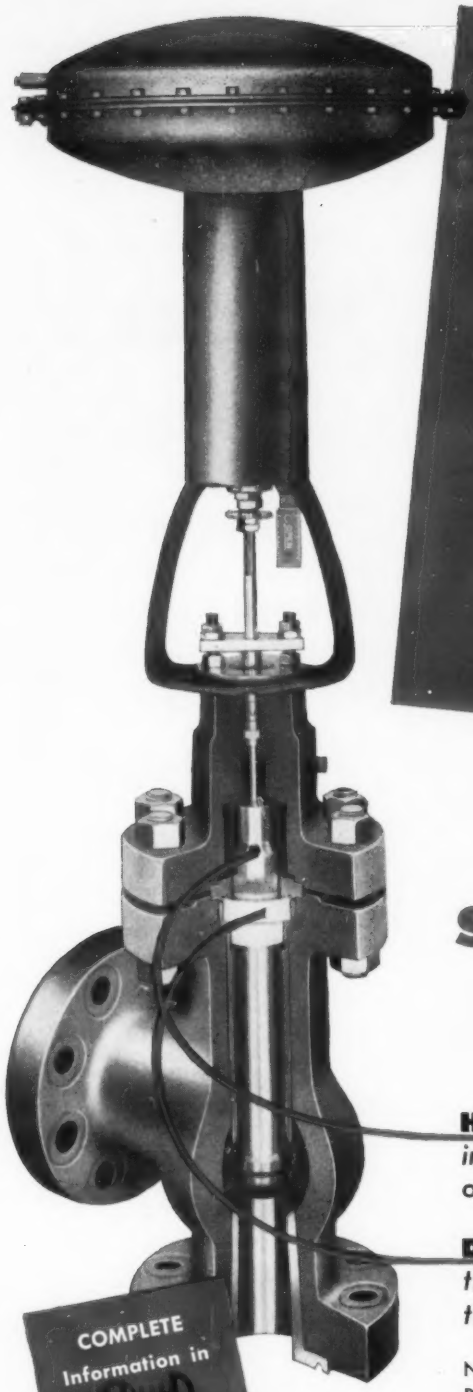
A network calculator, built by Westinghouse Electric Corp and valued at $240,000, will be installed at University of Wisconsin as a gift from Wisconsin Utilities Assn. The only one of its kind in the state, this instrument will enable users to solve many complex power system problems.

New Welding Procedures, a sound-color film, is now available from Eutectic Welding Corp. The company states that this is the first time a fully explanatory, step-by-step film on welding rod and electrode techniques and procedures has been offered. A 4-page booklet describing the film is available from Eutectic Welding Alloys Corp, 40-40 172nd St, Flushing 58, N. Y.

Consolidated Engrg Corp has released a new 30-minute color film, *Dynamic Measurement,* to acquaint potential customers with the role of instruments in science and industry. The 16-mm sound movie demonstrates how electromechanical and electronic devices have contributed to safety, comfort and convenience of modern living. For arrangements, contact Public Relations Dept, Consolidated Engrg Corp, 300 N Sierra Madre Villa, Pasadena 15, Calif.

Clark Equipment Co announces availability of a new sound film, "Over-the-Load Materials Handling." It deals with applications of the straddle-carrier type of industrial truck in the construction, metalworking, manufacturing and lumber industries.

Capacities of the carriers range from 5 to 22½ tons, and units are pictured operating on public highways as well as in plant yards. Running time 25 minutes.



THIS SINGLE-SEATED VALVE CONTROLS PRESSURE DIFFERENTIALS AS HIGH AS . . . . . .

3600 PSI with TIGHT SHUT·OFF

THE

HAMMEL-DAHL SEAL·BALANCED ANGLE VALVE

HOLO PLUG . . . *balanced to insure accurate positioning and optimum stability of operation.*

DAHL SEAL® . . . *eliminates leakage through the balancing port when the plug is seated.*

Nominal Sizes: 1" to 8"
Body Rating: 150# to 1500# A.S.A. STD.
Temperature Rating: To 450°F.

COMPLETE Information in Bulletin 104-B

HAMMEL-DAHL COMPANY

175 POST ROAD, (WARWICK) PROVIDENCE 5, R. I., U. S. A.

SALES OFFICES IN ALL PRINCIPAL CITIES

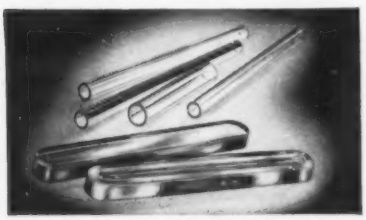
MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

What you can't see can hurt you!

Keep an eye on operations... with these Corning sight aids

PYREX brand sight glasses—Give you a good-sized "peep-hole" (2½" to 8⅜" diameter) into pressure vessels, furnaces, reactors, kilns. Resist all acids (except hydrofluoric). Retard corrosive action of steam. Thick, clear glass is easy to see through, gives added safety on pressure applications with minimum maintenance costs.

PYREX brand lubricator and oil cup glasses —Sturdy PYREX brand glass No. 7740 keeps breakage to a minimum. Gives you low-cost maintenance.



CORNING, PYREX, and MACBETH brand gauge glasses—Most complete line on the market. A glass for every industrial need: low to high temperatures; pressures up to 5,000 psi; extra readability; extra corrosion resistance. When buying gauge glasses, always buy "1 for the gauge and 2 for the shelf," to make regular or emergency replacements easy.

Your Industrial Distributor carries the complete Corning line of sight and gauge glasses. Call him today! He'll be glad to help you select the right glass for your needs!

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

More EQUIPMENT NEWS

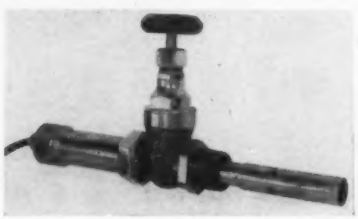
Begins on page 166

Hook-on Volt-Ammeter

637 • Pocket-size hook-on volt-ammeter is designed for balancing circuits, tracing faults and grounds, estimating distribution circuits and diagnosing operating troubles. Automatic scale changing feature is said to eliminate possibility of wrong scale reading. Meter will clamp around any conductor up to two inches in diameter. It has a current range of 5/20/80/350 amps, embracing the extent of currents normally encountered in industrial and commercial circuits.

General Electric Co, Schenectady 5, N. Y.

For more data on these items, use post cards p 175. Identify your request with item number.



Conductivity Cells

663 • New series of electrolytic conductivity cells for power-plant applications is designed for use with *Dynalog* conductivity instruments. These cells detect concentration of solids dissolved in feedwater, steam sample and condensate return to boiler. Units, having constants of 1, .1 and .01, are available in two types, both designed for insertion in pipeline or tank. Full specs available in tech report TI 27-H-60a.

Foxboro Co, Foxboro, Massachusetts

Silicone-enameled Wire

664 • Intended for use in electrical equipment operating at "hottest spot" temperatures of at least 130 C, new silicone-enameled magnet wire offers good abrasion resistance, adheres well to conductor and is not attacked by common solvents. Enamel will not crack when exposed to extremely low temperatures, such as –65 C. Dielectric strength is 1500 v/mil. Wire may be handled and stored as other enameled magnet wire. Full details on request.

Anaconda Wire & Cable Co, Muskegon, Michigan

Announcing

The 1954 edition of

Power's

"DIRECTORY of Manufacturers' Agents Serving the Power Field"

Contains name, location and accounts represented for more than 2,000 sales offices—in every state and in virtually every country.

- The only compilation of its kind, invaluable if you are analyzing, evaluating or rearranging your sales organization.
- Limited quantity.
  Price ten dollars per copy.

Power

330 W. 42nd Street
New York 36, New York

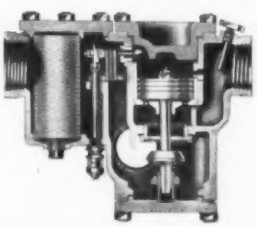
VELAN UNIVERSAL STEAM TRAPS

will keep power and heat ready for duty aboard the world's largest warship the U.S.S. FORRESTAL

OFFICIAL PHOTO FROM U.S. NAVY DRAWING

TYPE N-NAVY, FORGED

DRAINING ALL HIGH AND LOW PRESSURE SUPER-HEATED STEAM LINES



TYPE SP-PISTON OPERATED

THE SUPER CAPACITY STEAM TRAP DRAINING FUEL OIL TANKS AND CATAPULT DESUPERHEATERS

The U.S.S. FORRESTAL—world's largest aircraft carrier—will be a symbol of the power and readiness of the evergrowing U.S. Navy. Her 60,000 tons and overall length of 1040 feet will make her the largest warship in the world. Four catapults will launch as many as 32 intercepter planes in as little as four minutes. Only the most modern and dependable steam equipment was chosen for her rugged service. We are proud to have been entrusted with the task of building and supplying all steam drainage controls. Dependability and quality are the bywords in Naval engineering and Velan Steam Traps answer that very need with long efficient troublefree service.

WRITE TODAY FOR NEW CATALOG NO. 500-54

VELAN ENGINEERING LTD.

MAKERS OF THE MOST ADVANCED STEAM DRAINAGE CONTROLS THE PATENTED VELAN UNIVERSAL STEAM TRAP.

6585 JEANNE MANCE ST., MONTREAL, QUE. 414 DARBY ROAD, HAVERTOWN, P.A.

R/M's BIG 7 Packing Types meet 95% of all packing needs

Triplex pumps like this one, which is used to supply hydraulic pressure for molding presses, give top performance with R/M Vee-Flex®, a packing included in Type 7 of R/M's "Big 7" Packing Types.

Let R/M packings reduce your downtime

With R/M's "Big 7" Packing Types you will be able to practice preventive rather than corrective maintenance. With them you will have greater assurance of machinery protection and a chance to schedule your downtime. You will, because this basic line of just seven field-tested packing types is engineered to give custom-built performance in all but the very rarest packing applications. Your plant can probably standardize on just three or four of R/M's "Big 7" Packing Types. If so, this also means lower inventories and simplified ordering. Your R/M distributor has the full details. Call him in and start benefiting right away.

R/M PACKINGS FOR MAINTENANCE PURPOSES ARE SOLD ONLY THROUGH AUTHORIZED R/M DISTRIBUTORS

R/M

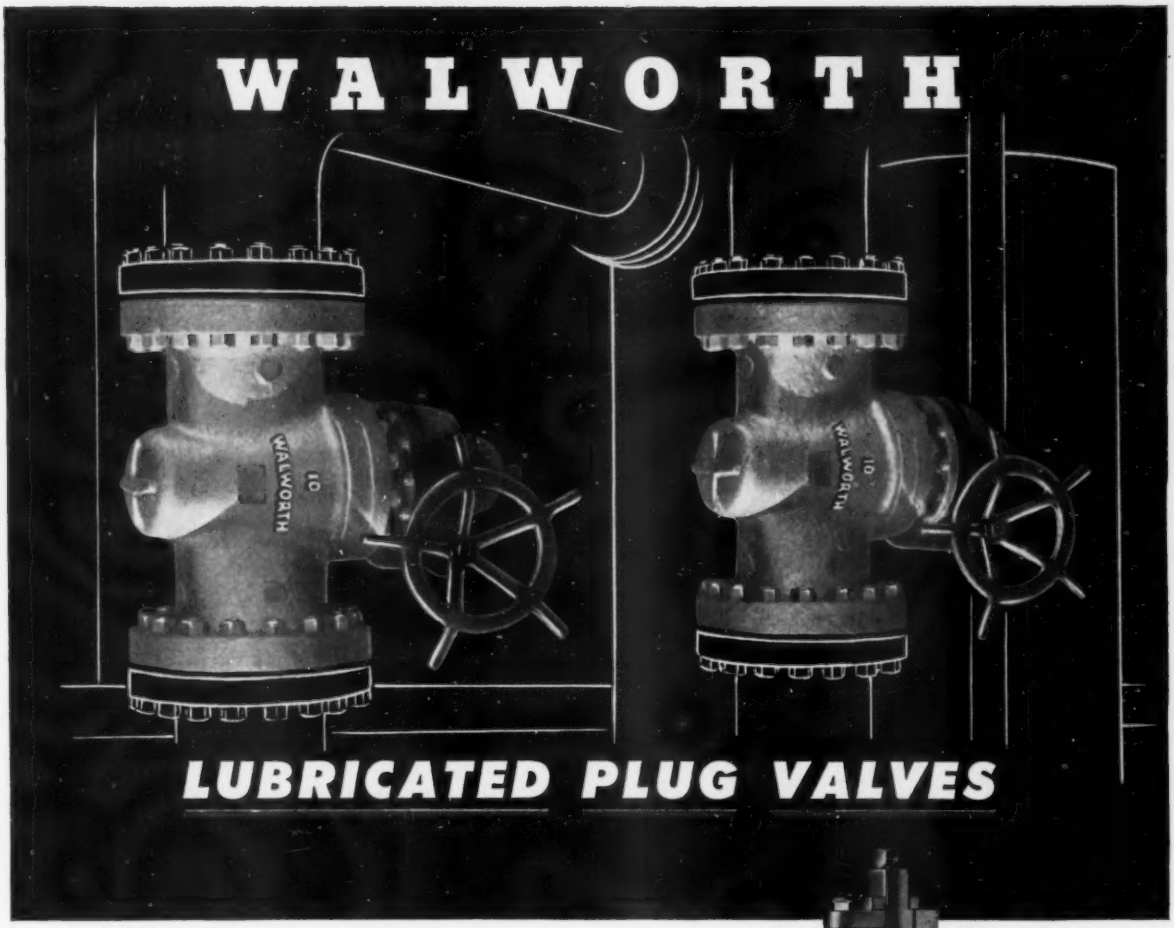
RAYBESTOS-MANHATTAN, INC., PACKING DIVISION, MANHEIM, PA.

BIG 7 PACKINGS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

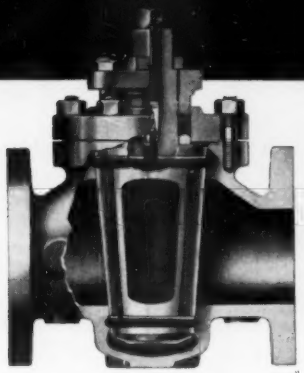
RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

WALWORTH



LUBRICATED PLUG VALVES

Better because . . . **They are pressure sealed with an insoluble lubricant readily renewed while the valve is in service. Lubricant completely surrounds the plug ports assuring a tight seal against leaks. It also insures ease of operation by reducing friction between the body and the plug while at the same time protecting the finished surfaces against corrosion and wear.**



Lubricant system of a Walworth No. 1700F Regular Gland, Wrench Operated, Steel-iron, *Lubricated Plug* Valve. Other Walworth *Lubricated Plug* Valves include Single Gland, and Ball Bearing types. Sizes to 30-inches — pressures to 5,000 psi, and for vacuum service.

Walworth Lubricated Plug Valves are the most satisfactory valves available for the handling of gritty suspensions, and many other destructive, erosive, and corrosive industrial and chemical solutions.

They are ideal for general refinery and pipeline service.

For full information see your Walworth Distributor, or write for your copy of Bulletin 111. Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

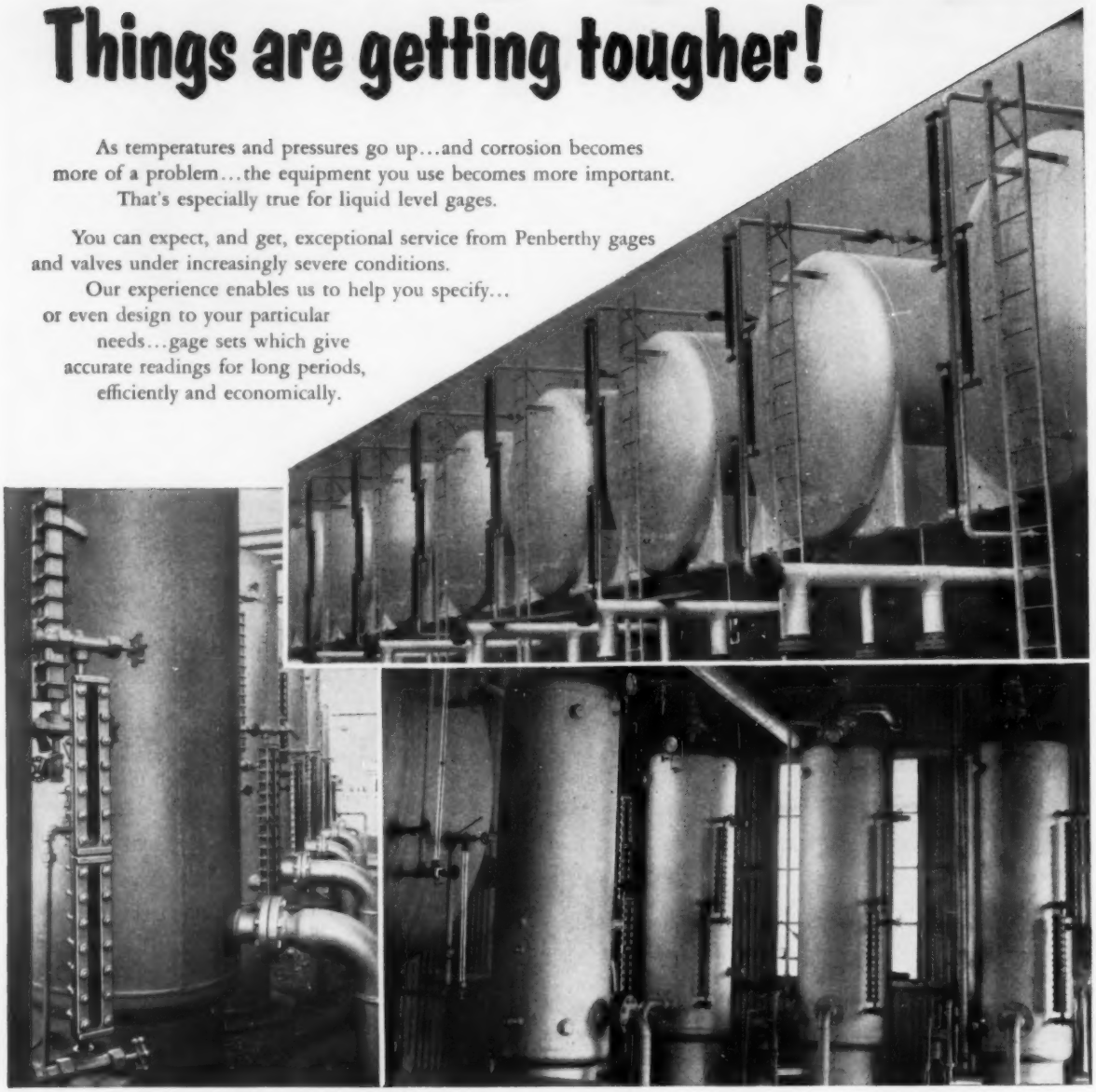
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Things are getting tougher!

As temperatures and pressures go up...and corrosion becomes more of a problem...the equipment you use becomes more important. That's especially true for liquid level gages.

You can expect, and get, exceptional service from Penberthy gages and valves under increasingly severe conditions.

Our experience enables us to help you specify... or even design to your particular needs...gage sets which give accurate readings for long periods, efficiently and economically.



● *To help you in specifying the right gages for your needs, write for Catalog 35. If your requirements are special, put our engineers to work on them.*

PENBERTHY INJECTOR COMPANY
Division of the Buffalo-Eclipse Corporation
1242 Holden Avenue • Detroit 2, Michigan
Established 1866

Penberthy gage sets are made from carbon, chrome-moly and stainless steel as well as Monel metal. They are also available in acid bronze, Everdur, nickel and Hastelloy. All materials conform to or exceed requirements for maximum recommended pressures and temperatures. The finished products are rigidly inspected and tested under actual working conditions.

And, only with Penberthy Gages, do you get such features as the "Floating Shank" which automatically compensates for as much as ⅜" variation in center-to-center distance of the vessel tapping.

There's Certain satisfaction in **PRODUCTS BY** **PENBERTHY**

- **CYCLING JET PUMPS**
- **EJECTORS**
- **INJECTORS**
- **ELECTRIC SUMP PUMPS**
- **EDUCTORS**
- **EXHAUSTERS**
- **SYPHONS**

fabricated and erected by Blaw-Knox

high pressure tunnel piping system

. . . in large steel mill

You may sometime have the problem of installing a complex piping system in a confined space, like this one. Or your problem may be even more difficult . . . or relatively simple. But whatever it is, we have the experience and facilities to handle the entire job. Always, of course, in close cooperation with your consultants or your own organization.

In our organization you'll have the benefit of a group of engineers who can help you solve problems that involve piping.

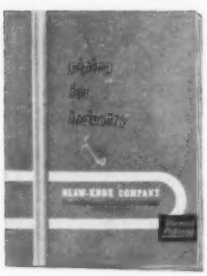
You'll have modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory to assure you of the latest developments in high pressure, high temperature piping. The most modern testing equipment to insure that the piping is sound and sturdy enough to withstand the most severe operating conditions.

Plus a complete service force equipped with modern machinery for field work and erection . . . and the necessary manpower to handle any size job.

What kind of service would you want?
We are prepared to (1) engineer, fabricate and erect your job . . . or (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, where desired, make a field study of your piping requirements before quoting.

Just tell us your service requirements . . . and we'll provide them.



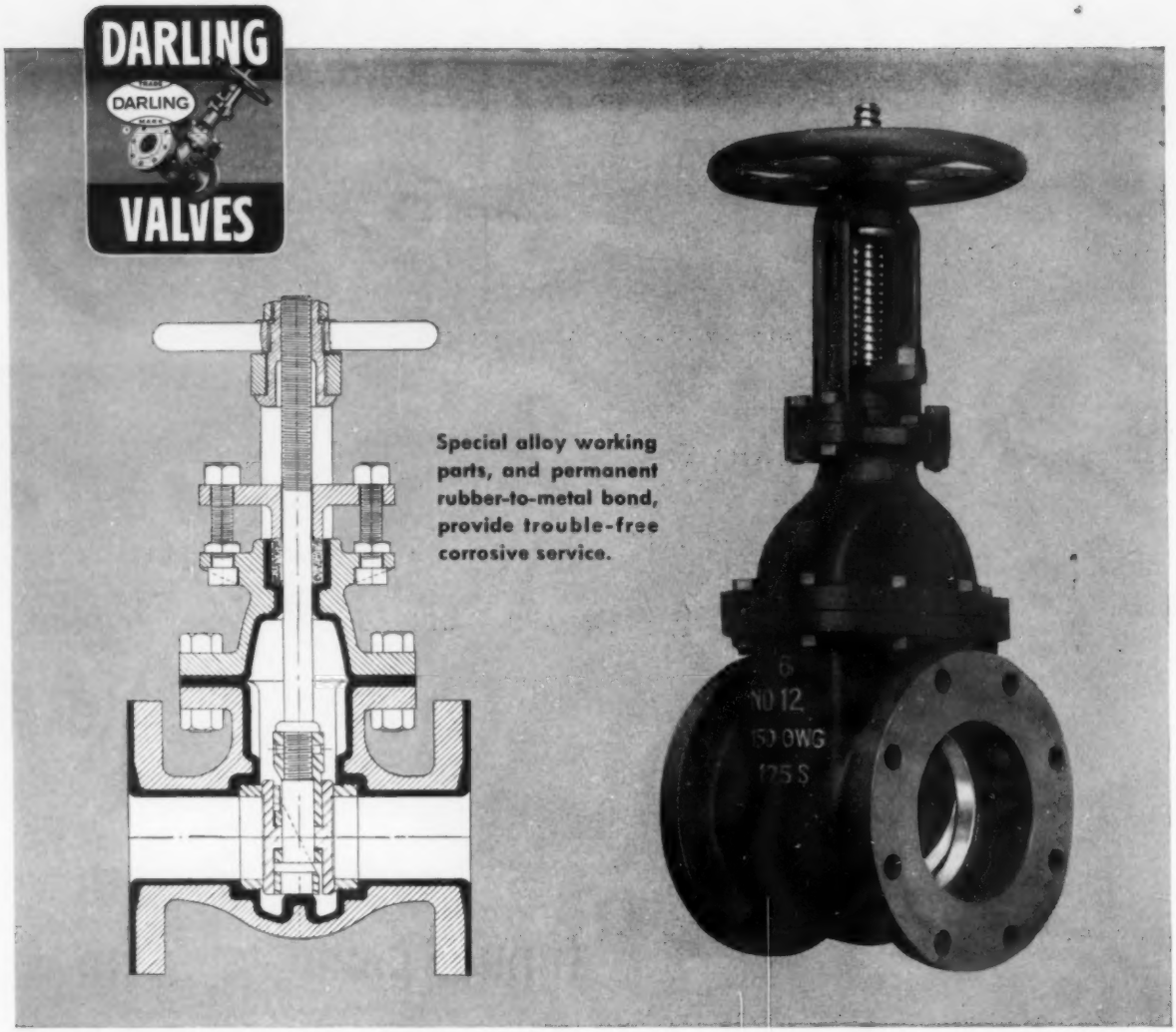
To get more information on piping for industry write for your copy of Bulletin No. 2443.

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pa.

BLAW-KNOX

POWER PIPING

Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators



Meeting the "Acid Test" the low-cost way with DARLING rubber lined iron body valves!

YOU can save dollars by installing Darling rubber lined, iron body gate valves for corrosive services up to 150°F. These Darling gate valves are giving outstanding service in job after job.

You Get This Plus Value Too!

The *fully revolving double disc,* parallel seat principle compensates automatically for valve body distortion. Tight closure is assured every time. And wear on working parts is *uniform.*

In plant after plant Darling rubber lined, revolving disc, parallel seat gate valves are setting records of efficiency and economy. These unique rubber lined valves are made in rising stem, cylinder, motor-operated, or quick-opening types.

Ask for the special Darling rubber lined *gate* and *check* valve bulletin.

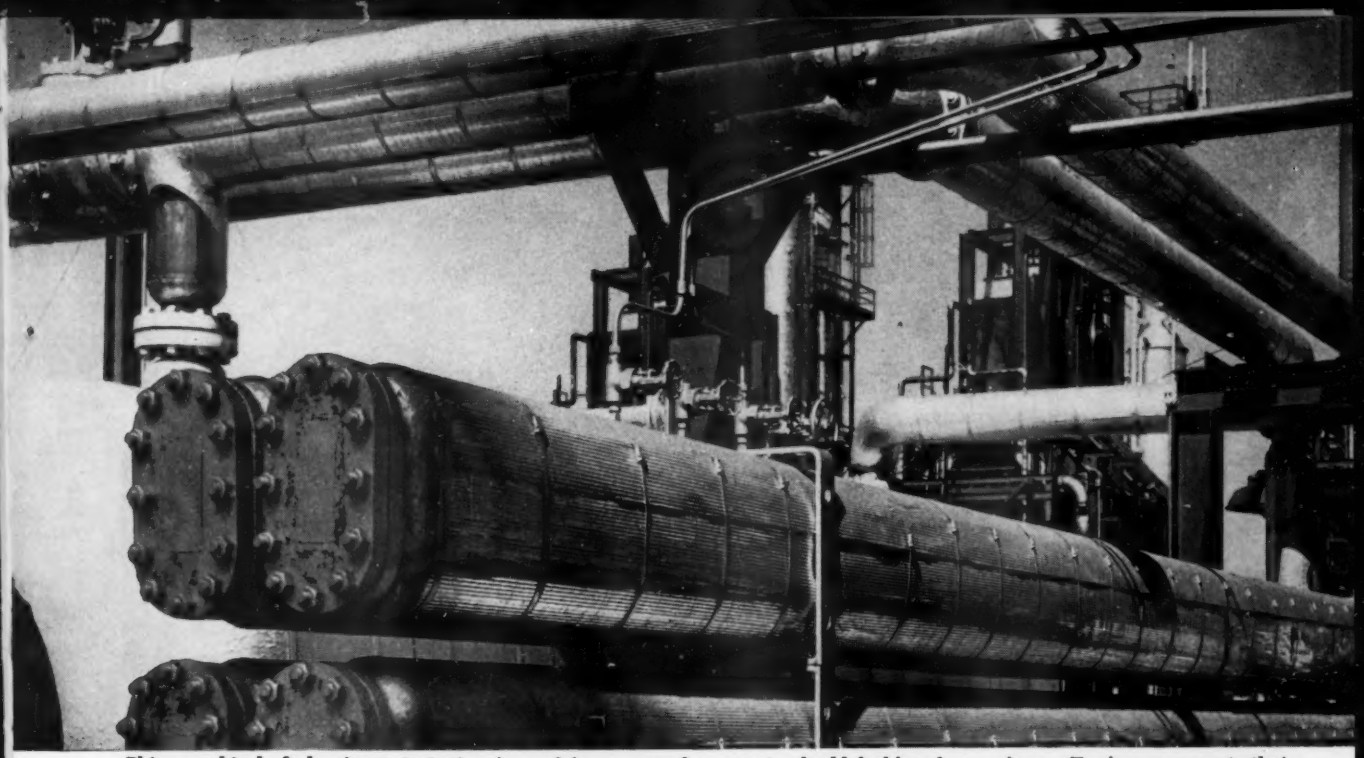
VALVES FOR EVERY NEED

Darling also offers gate valves in a wide range of sizes, types and construction for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt, 19, Ontario



This new kind of aluminum jacketing is used in more and more outdoor processing plants to protect insulated towers, vessels, lines—it eliminates costly maintenance and replacement of old-fashioned coverings. Engineers report that Childers Jacketing has advantages not found in expensive heavy sheet aluminum, costs less to buy, far less to apply.

New Aluminum Jacketing Protects Insulated Lines...Cuts Costs 28%

How 986 of America's Leading Companies Saved Money By Weather-proofing Insulated Lines This New Way:

A two-man crew can apply the jacketing fastest. Only tools are a pair of pliers and a wedge or screw driver as shown here. Note how easily the jacketing forms around the pipe.

Aluminum strapping can be pulled plenty tight enough with just pliers like this. No special strapping tool needed. Strapping is pulled down between lugs and bent over.

Up-to-date appearance, low cost, and long life go hand in hand in a new aluminum jacketing for insulated lines. Developed by Childers Manufacturing Co., Houston, Texas, it is the first permanent weather-proofing that offers both low initial cost and low application cost.

Childers Jacketing, made of tough 3S aluminum alloy for maximum corrosion resistance, lasts years without painting or other maintenance. It costs less than even the cheapest kind of weather-proofing, when the cost of one paint job is considered. Savings run up to 28%.

Cost-minded engineers are also impressed with the gleaming beauty of Childers Jacketing that means "good plant housekeeping."

Available with moisture barrier attached, for use over 85% magnesia insulation.

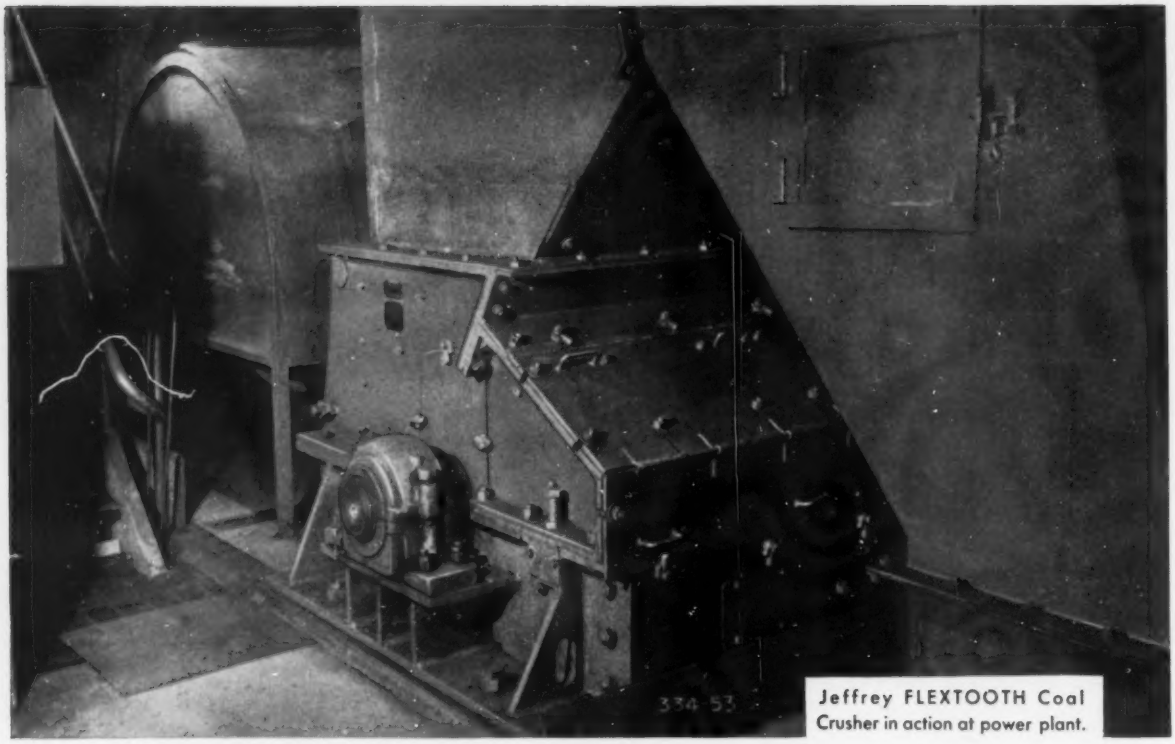
5 years of tests and major installations in 986 of America's leading processing plants, refineries, and power plants have proven the advantages of Childers Aluminum Jacketing over other types.

Try this low-cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation.

Address Childers Manufacturing Co., Dept. PO-8, 3620 W. 11th St., Houston 8, Texas.

Engineering representatives in all principal cities to work with you on your problems.

This is how the flexible, easy-to-handle Childers Jacketing arrives at the job site. It is in convenient rolls 4 feet wide and 100 feet long—just right for one man to handle—and is available either with or without a moisture barrier attached on the back of the .006" aluminum "skin." It can be cut to proper lengths using any flat table and a straight-edge. (Advertisement)

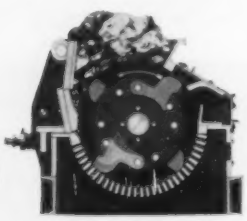


Jeffrey FLEXTOOTH Coal Crusher in action at power plant.

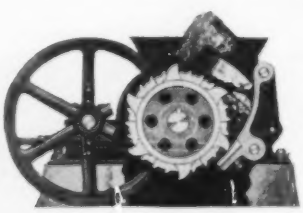
JEFFREY coal crushers insure constant supply of right sizes

Jeffrey's long experience with crushing problems assures that the coal sizing installation for *your* power plant will give greatest profit and satisfaction. Our engineers have developed a complete range of crushers that produce a constant supply of uniform sizes for top operating efficiency.

Jeffrey FLEXTOOTH and Rotary Ring Crushers were especially designed for stokers and powdered fuel plant grinders.



FLEXTOOTH Coal Crusher



Jeffrey Single Roll Crusher

CHECK THESE TEN OUTSTANDING FEATURES:

1. Reduces run-of-mine coal in one operation down to and including ¼".
2. Rugged construction with all-welded steel frame.
3. Highest grade roller type bearings.
4. Renewable steel crushing elements swing back on contact with tramp iron.
5. Heavy fly wheel pulley furnishes belt drive direct to motor.
6. Hinged breaker plate gives easy access to interior from front.
7. Built-in metal catcher may be emptied easily without stopping production.
8. Hinged doors at back have T headed bolts and latches. No bolts to lose when doors are opened.
9. Low frame requires no more head room than ordinary crusher.
10. Large screen bar area assures large capacity and uniform product.

WRITE FOR CATALOG 784-B

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

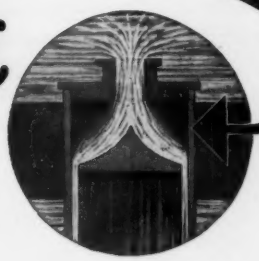
PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED

. . .IT'S A JOB FOR JEFFREY!

Dirty Water can't "Shut-down"...

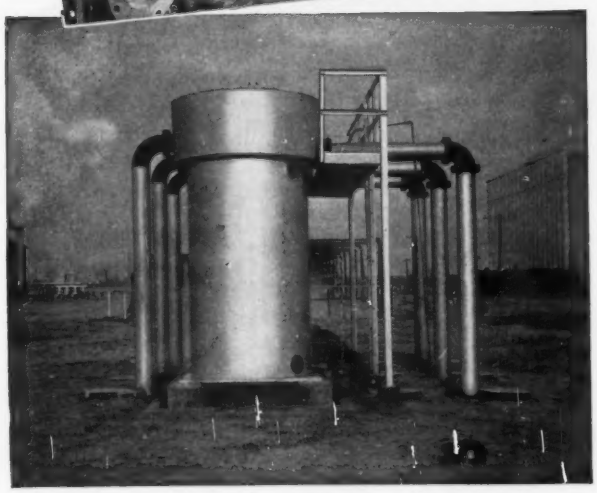
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

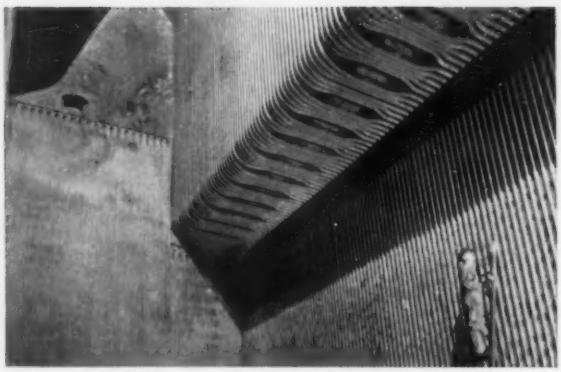
BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

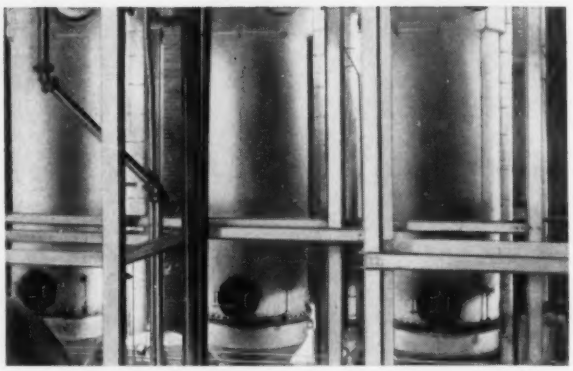
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

There's no limit to what you can do with the right tubing!



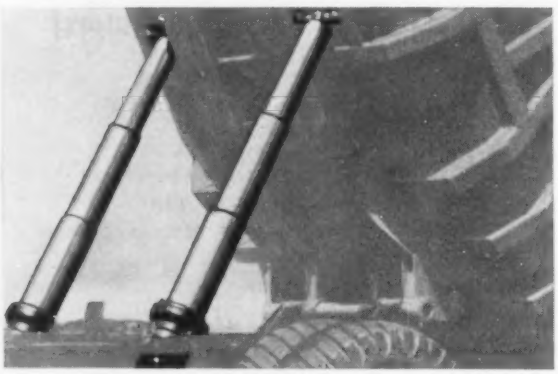
make power to light a city . . .

There are more than 12 miles of Globe seamless pressure tubing (carbon, alloy, and stainless) in this modern boiler which is a vital part of the electric power plant that serves a large metropolitan community.



transfer corrosive liquids . . .

Black liquor, used in production of kraft papers, is highly corrosive and has to be carried under pressure in multiple effect evaporators. Gloweld (electric welded) Stainless Steel Tubing was found to do the job best—at lowest cost.



or lift a load of dirt . . .

Mounted on a dump truck, these twin hydraulic hoists are built to handle heavy loads. Design and production is simplified by making the telescoping arms of Globe mechanical tubing.

THERE are probably a thousand and one different tube applications that could be made in your own products or industry. Check the possibilities. Globe engineers will be pleased to give helpful advice on how the right tubing — Globe tubing — can help you save time, save money, save manpower. Write for literature on any of these products.

GLOBE STEEL TUBES

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A quick check list of GLOBE STEEL TUBES

ALLOY STEEL: to meet heat, corrosion, pressure, and structural strength problems. Carbon Moly, Chrome Moly Nickel and others. Sizes: O.D. from ½ to 6 inches. Wall thickness .035 to 1.000 inch.

CARBON STEEL: for load bearing structural members with strength, least weight . . . for fast, low-cost manufacturing of machine parts or pressure tubing applications. Low and medium carbon. Sizes: O.D. ½ to 7½ inches. Wall thickness: .028 to 1.000 inch.

STAINLESS SEAMLESS: in sizes from ½ inch to 6 inches O.D., and in pipe sizes ⅛ inch to 6 inches, standard, extra strong and double extra strong weights.

STAINLESS WELDED: Gloweld electric welded stainless steel tubing offers many economies. Sizes: O.D. ¼ to 5 inches. In standard wt. pipe sizes ⅛ to 2 inches. In lightweight pipe sizes ⅛ to 4½ inches inclusive.

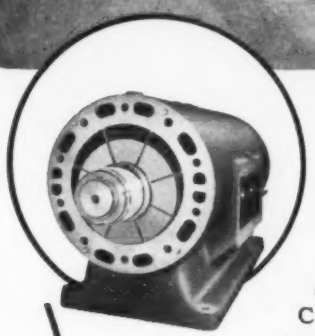
HIGH PURITY IRON: Globeiron tubing is 99.5% pure ingot iron. For applications where ductility, toughness, easy weldability and easy forming are desired or for use where magnetic permeability and electrical properties are required.

SPECIAL ANALYSES: Globe Steel Tubes Co. regularly produces tubing to special customer specifications. Consult with Globe's representatives for analyses to suit your needs.

GLOBE WELDING FITTINGS: seamless, carbon and stainless, available in a complete line of sizes and weights through Globe distributors in key cities.

FULLER ROTARY AIR COMPRESSORS

WORK FOR WESTERN ELECTRIC



Long periods of continuous operation don't overtax these Fuller Compressors at Western Electric Co. plant at Indianapolis, Ind., where two 3300 cfm. two-stage duplex units and one 1665 cfm two-stage single unit supply all plant needs at 100 psig.

Endurance, plus efficiency, are results of the rotary principle employed in these compressors. Elimination of reciprocating parts does away with flow pulsations, cuts down on vibration and need for continual take-up of bearings. Another feature of interest to cost-conscious engineers is the limited maintenance required by Fuller Rotary Compressors—rotor, blades, and bearings are the only moving parts.

Because these compressors do not require valves, top overall efficiency is maintained at all times—no capacity is lost around leaking valves, no time lost to grind seats. Fuller Compressors do not require driving mechanisms nor speed change gears—they are designed to operate at common electric motor and internal combustion engine speeds.

You'll find these compressors stay on the job, operate with sustained high efficiency and require little maintenance. If your plant requires air in volume, it will pay you to investigate the advantages of Fuller Rotary Compressors. A Fuller engineer will discuss them with you.

Fuller

FULLER COMPANY, Catasauqua, Pa.
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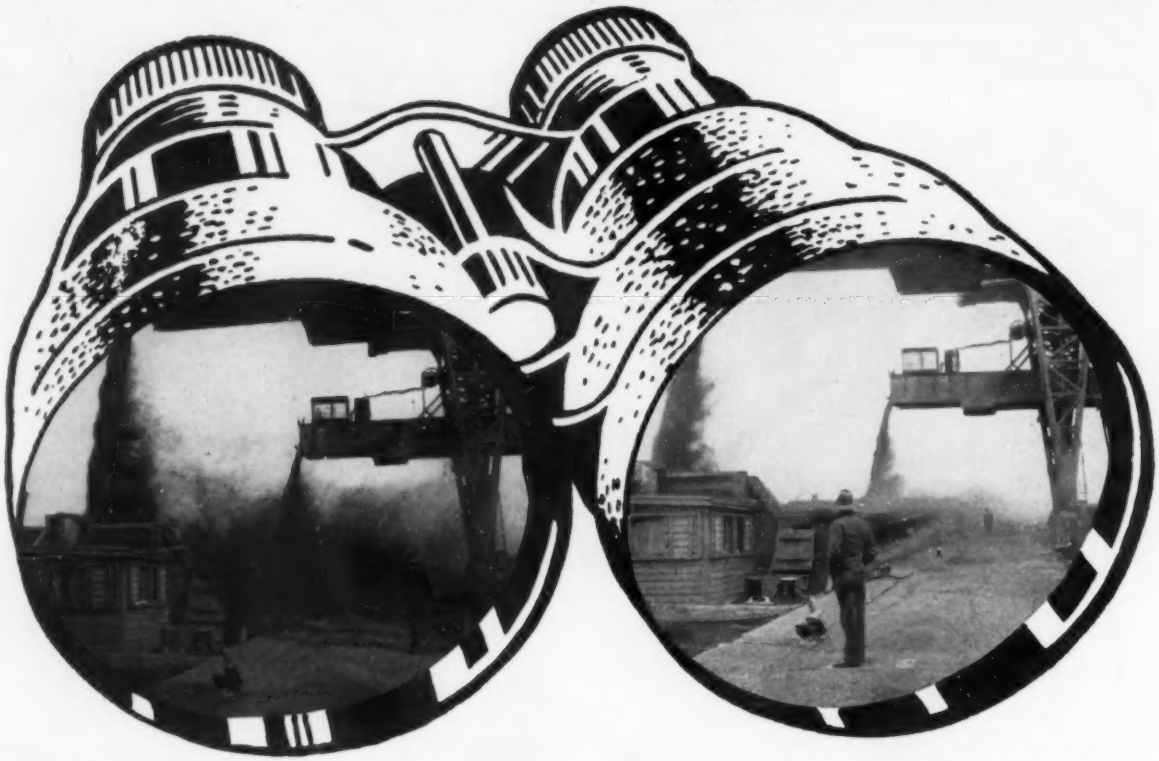
DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—
COMPRESSORS AND VACUUM PUMPS—
FEEDERS AND ASSOCIATED EQUIPMENT

C-214

Look how this dock Stops Coal Dust



BEFORE—Barge loading of carbon size coal (¼" minus) at Eastern Railroad Coal Dock operating without the application of Johnson-March Compound "M". Note volume of dust.

AFTER—View of the same loading operation with a Johnson-March engineered system in operation. Note effective suppression of dust.

Here's how YOU can STOP COAL DUST!

A LOW COST Johnson-March engineered dust control system in operation in your plant enables you to eliminate the community dust nuisance and the threat of fires and dust explosions.

CONTROLLING COAL DUST in your power plant will "pay off" in reduced maintenance costs, and safer working conditions.

MANY LEADING POWER PLANTS now stop coal dust right at its source at car dumpers, hoppers, belt galleries, crushers and storage piles, with a Johnson-March System.

JOHNSON-MARCH ENGINEERED SYSTEMS cost only 1/10 that of mechanical systems, and maintenance cost is next to nothing. No bulky ducts, hoods or fans to interfere with normal operations.

IF YOU now have no control over coal dust . . . or if you want to improve the effectiveness of an existing mechanical dust collection system, talk over your requirements with Johnson-March engineers. Drop us a line today.

Johnson March

Dust Control Engineering

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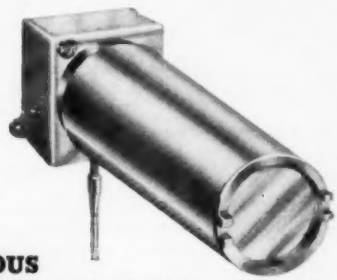
new weatherproof housing protects camera from cold, heat, snow, and rain—makes RCA Industrial TV a true round-the-clock, round-the-calendar instrument.



FOR HAZARDOUS CONDITIONS—new explosion-proof housing lets you place your camera in any location too hazardous for your personnel.

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RCA's new water-cooled lens permits direct viewing of operations where temperatures run up to 2900°F.

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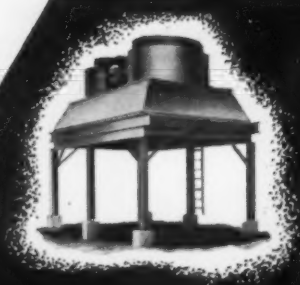
Efficient production demands modern facilities. These facilities require top-performing equipment.

That's why your installation needs a superior cooling tower . . . like this heavy-duty Pritchard unit that cools the circulating water that cools the condensers that cool the generators in this modern power plant.

Hundreds of industrial power and process installations demonstrate the dependability of Pritchard to meet the exacting requirements of vital cooling operations anywhere along your production line.



You'll obtain maximum heat transfer . . . with maximum savings . . . in many process cooling operations from Pritchard QUINTAIR* heat exchangers. The induced draft design assures high efficiency with more even distribution of air over the coils carrying the product to be cooled or condensed.

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FINANCIAL AID TO HIGHER EDUCATION

Our Colleges and Universities Face Grave Financial Problems

For the past decade the nation's colleges and universities have been caught in a destructive financial squeeze. It is particularly destructive for the independent, privately endowed institutions. Unless extraordinary measures are taken to relieve this squeeze, it promises to become progressively worse. To let it do that is to court a national disaster.

This is the first of two editorials devoted to the financial plight of our colleges and universities. This first editorial deals with the character of the problem, present and potential. The second will indicate some things that need to be done about it, and particularly what American business might do.

Enrollment Soars, Income Lags

In broad outline, the financial problem that afflicts our colleges and universities is simple. The demand for their services has increased rapidly, and promises to keep on increasing even more rapidly. At the same time, their financial capacity to provide these services has lagged behind, primarily because of price inflation.

Between 1940 and 1950, college and university enrollment increased from approximately 1⅓ million to 2⅓ million—about 75 per cent. Over the same period, the educational income of these institutions, measured in terms of its actual purchasing power, increased only about 64 per cent. Thus, at the end of the decade, our colleges and universities as a group had, on the average, about 6 per cent less to spend per student than they had at the beginning. Meanwhile, the rapid advance of science and technology had made a good college or university course a much more expensive operation than it was in 1940. Since 1950, the latest date for which comprehensive figures are available, the financial squeeze on our colleges and universities has intensified, largely because of another wave of price inflation touched off by the Korean War.

Among the colleges and universities, the independent, privately endowed institutions are particularly hard pressed. In terms of actual purchasing power, the independent liberal arts colleges are now spending at least 20 per cent less per student than they spent in 1940. Public institutions of higher learning, supported out of tax revenues, have managed to increase slightly their expenditure per student. Otherwise, the financial squeeze on higher education as a whole would be even more severe.

Why Independent Colleges Are Hit Hardest

The principal reason why the independent colleges and universities are so hard up is the shrinkage in their income from endowments. These endowments, created in other days by gifts of generous benefactors to help pay the expenses of higher education, have been hit hard from two directions. During the war and post-war years, the tax collector took so large a part of the incomes and estates of wealthy people that this source of endowments has been greatly reduced. Over the same period price inflation cut in half the purchasing power of the income derived from existing endowments. In 1940 income from endowments provided 26 per cent of the total income of the independent colleges and universities. By 1950 it provided only 14 per cent. The figure is still lower today.

The financial plight of the independent colleges and universities is directly reflected in the salary status of their teaching staffs. In mid-1952 a national survey showed that, after adjustment for the increased cost of living, the salaries of those holding full professorial rank in these institutions were 12 per cent lower than they were in 1941-42. Junior teachers, with the rank of instructor, fared somewhat better. In terms of actual purchasing power, their salaries declined only 2 per cent over the 12-year period, largely because there is more direct competition for their services from industry. Over the same period, the real wages of industrial workers increased 55 per cent.

Time Will Not Provide a Cure

The plight of the colleges and universities, which is shared in some degree by all parts of our educational system, is not one that can be left to time for a cure. On the contrary, the financial problems of our institutions of higher learning will be intensified in the years ahead by the pressure of rapidly increasing enrollments. Present prospects indicate that during the next decade college and university enrollment will increase by about one-third, or from 2⅓ million to over 3 million. The problem of increased enrollments will become particularly acute toward the end of this decade when the babies born during the great surge of population in World War II are ready to enter college.

Such an increase in population as that now in prospect can be a tremendous asset to the nation. It is still a truth, even though it is worn a bit thin by frequent repetition at commencement exercises, that a nation has no resource more valuable than the education of its people. And the better the education, the more valuable the asset.

But to realize this, our colleges and universities must have the financial strength to handle the increased enrollments that face them in the years ahead. This means that we must relieve our independent colleges and universities, in particular, from the financial squeeze in which they are now caught and make them full partners in the economic well-being of the nation. Some of the means by which American business might help achieve this will be discussed in a second editorial.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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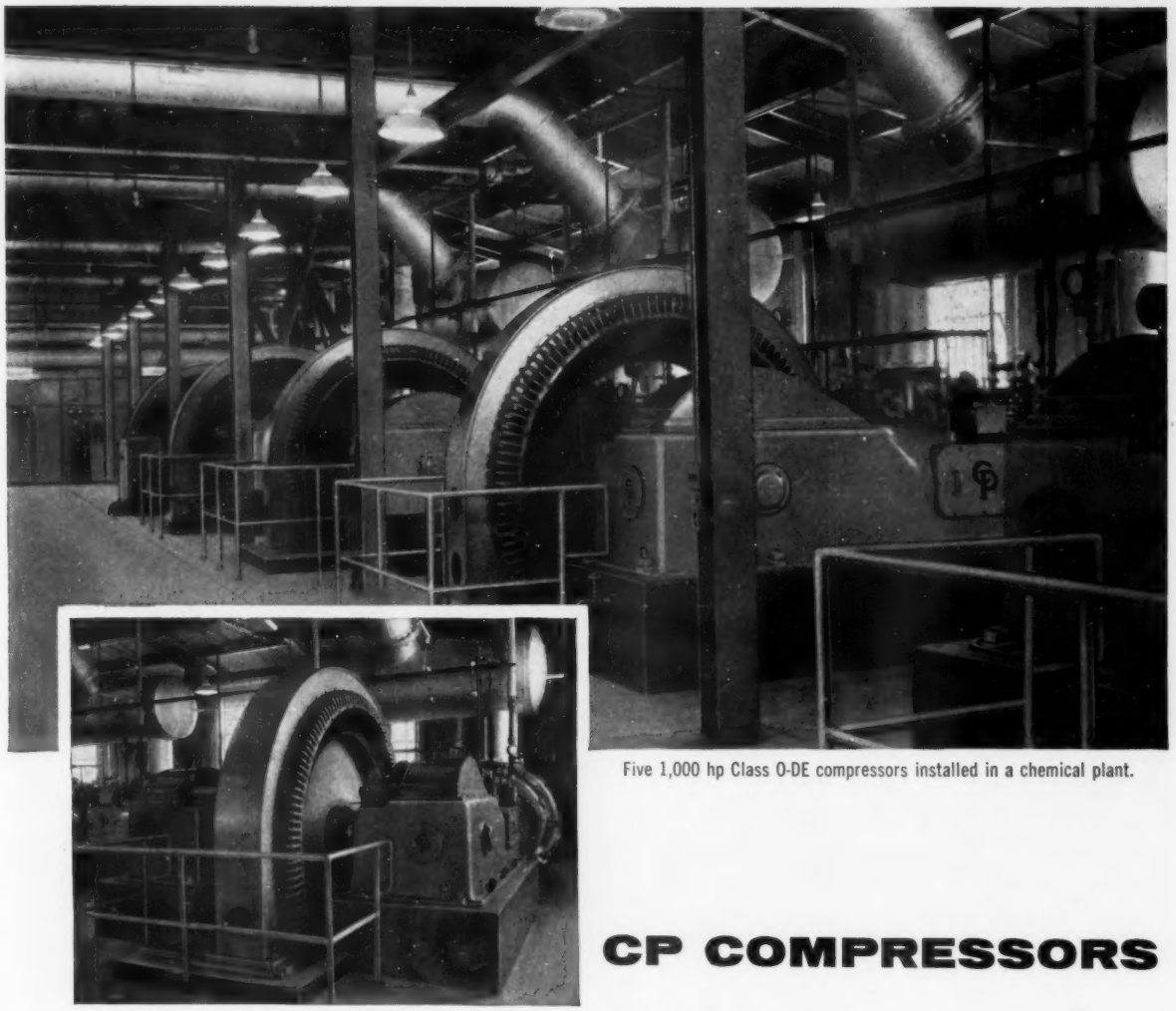

Five 1,000 hp Class O-DE compressors installed in a chemical plant.

CP COMPRESSORS

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Chicago Pneumatic's heavy duty, Class O Compressors are a prime favorite where 24 hours-a-day service is required.

Engineered for continuous, heavy-duty usage, the Class O affords complete dependability with low operating cost. And they require minimum attention and upkeep. Built in sizes up to 2,000 hp, they're available in single and multi-stage designs, steam and electric drives, for a wide range of pressures. For more information write for Bulletin 726. *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*

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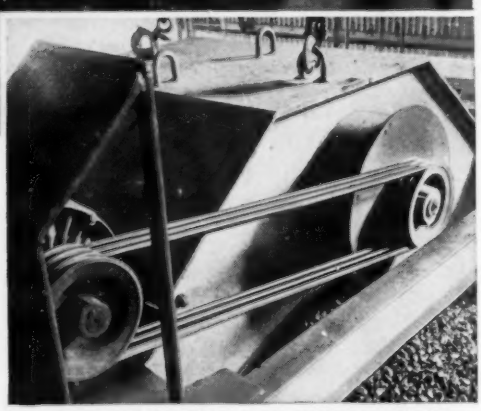
U. S. Rubber V-Belts have been taking this shock treatment for over 3 years!



Two views of drive of heavy-duty coal car shakeout. This shakeout handles over 30 cars a day, is equipped with a matched set of three C-144 super-service V-belts.

The V-Belts on this coal car shakeout must transmit the power to shake the car to loosen tons of packed or frozen coal. Yet this matched set of U. S. Royal® Super-Service V-Belts has been working steadily on this shakeout *for more than 3 years*. Three other brands of belts lasted an average of only 3 weeks. Moreover, the "U. S." belts withstood the extreme shock load... never jumped the pulleys.

Part of this success stems from the unique Equa-Tensil Cord Section built into U. S. V-Belts. This development makes certain each cord pulls its *full* share of the load. Order from your distributor, or get in touch with any of our 25 District Sales Offices, or write to address below.

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Guaranteed TO SHUT TIGHT*

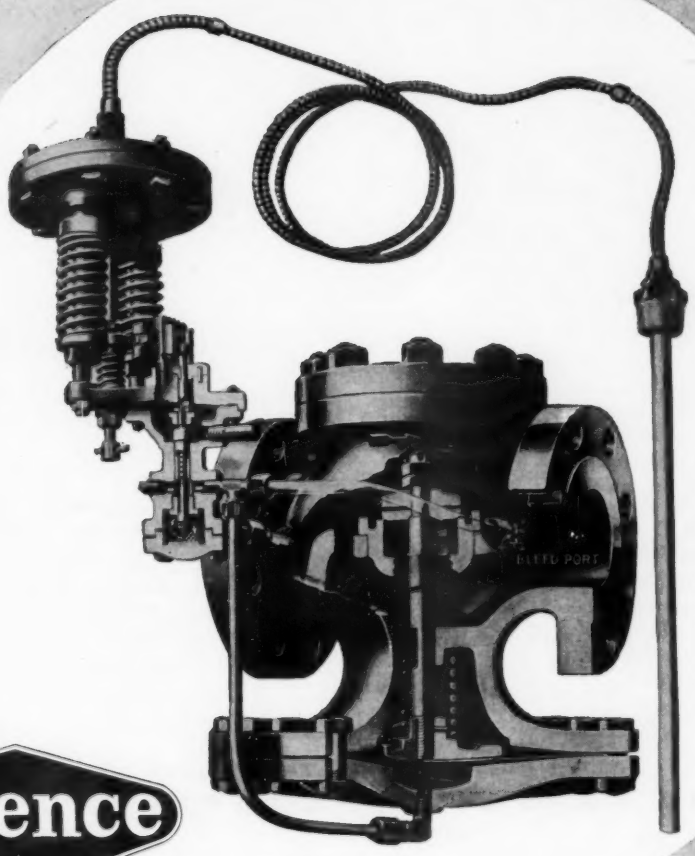
* When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.



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TYPE ET150
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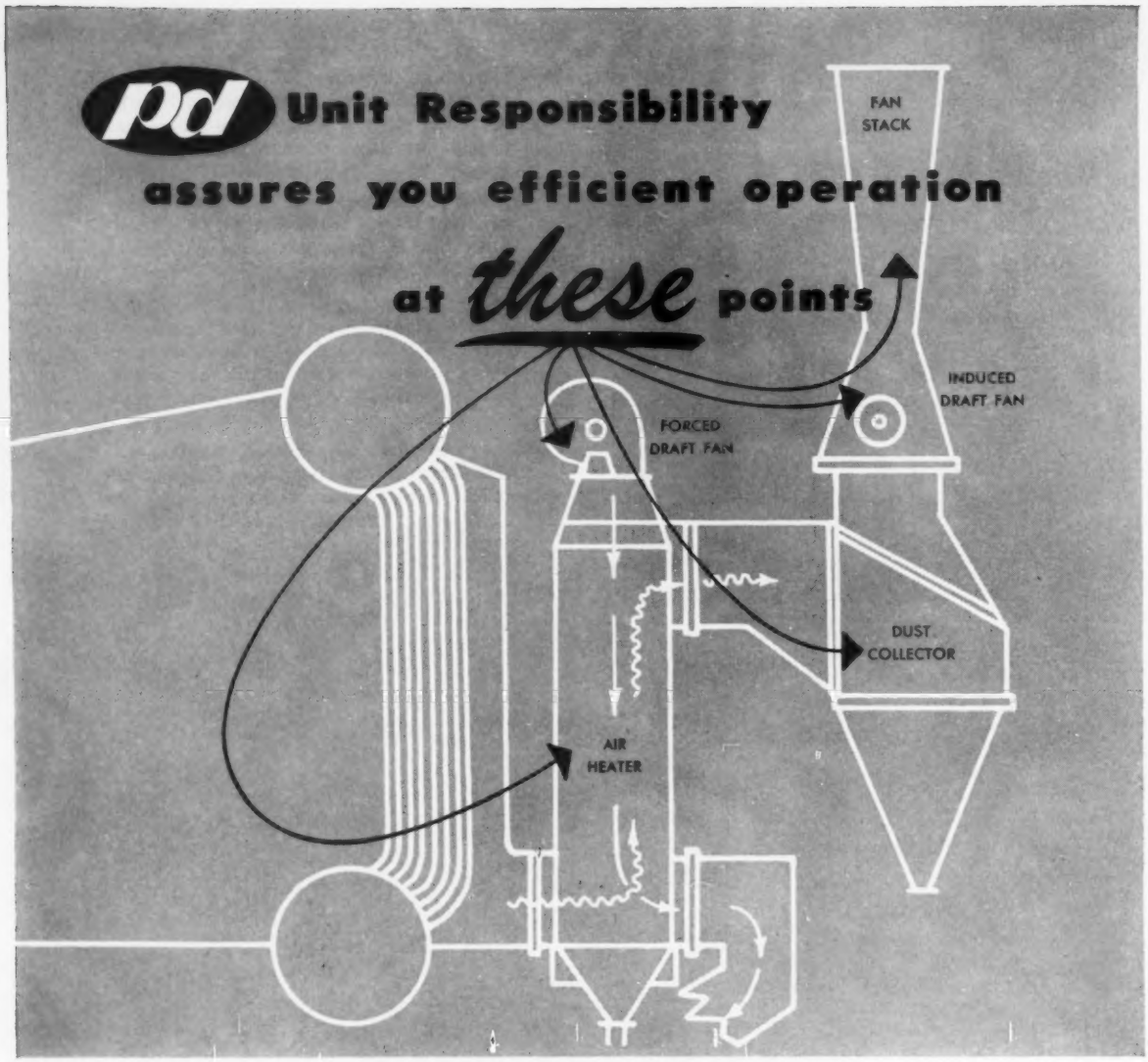
P-D Unit Responsibility assures you efficient operation at *these* points



Unit Responsibility, for important components of plant design by the Prat-Daniel Corporation, relieves your engineers of necessary problems of coordination that often arise when equipment is purchased from several sources.

Prat-Daniel, designing and manufacturing engineers of *Forced Draft Fans, Air Preheaters, Tubular Dust Collectors, Induced Draft Fans* and *Fan Stacks*, make possible this coordination of components by a single company with over a quarter of a century experience in the power field.

This service is offered through The Thermix Corporation, project engineers for Prat-Daniel. Specialists in this field, they can assure you a completely integrated system. Why not contact Thermix today. Ask for the new P-D Bulletin 4P201.

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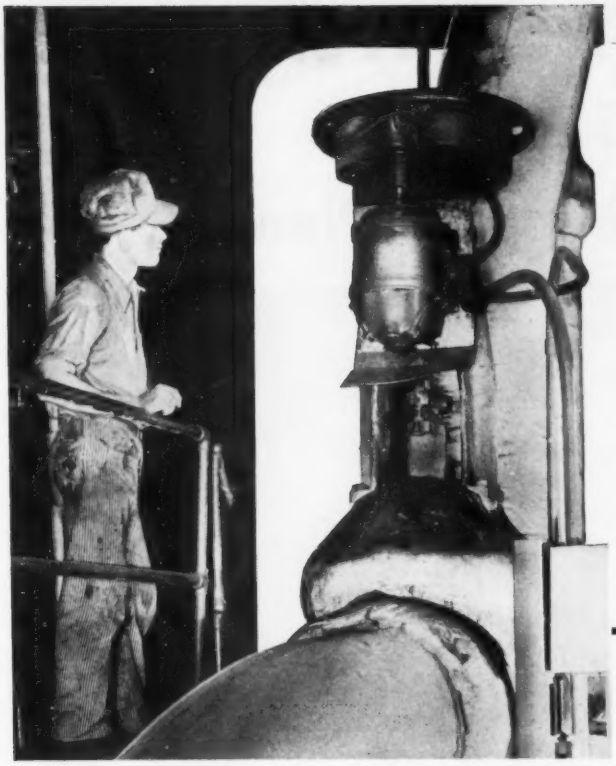

Not a cent for repair or replacement

. . . of Monel parts in more than 27 years!

Continuous Performance. Installed by the Potomac Edison Company in 1927, this Chapman valve has stem, seat and disc rings of long-lasting Monel. Not a single one of these Monel parts has ever given trouble, and the valve itself is still in perfect operating condition.

Let's *all* take a careful look at this valve.

It's a 16-inch motor-operate l Chapman. You'll find it on the No. 3 unit main steam header at the R. Paul Smith Station of the Potomac Edison Company, in Williamsport, Md.

When it was installed in 1927, no one was sure exactly how long its Monel® stem, Monel seat and Monel disc rings might last.

And no one knows, even *today*. This Chapman valve—now well past the quarter-century mark—is still in operation, still working perfectly. Despite more than 27 years of service at 350 W.S.P. and 700°F., not a single Monel part has ever needed a penny's worth of repair!

Remember this performance next time you need valves. Specify Monel trim and you insure yourself against frequent repair bills and costly maintenance expense.

In Monel, you have a metal that is stronger than structural steel, and harder than most non-ferrous metals. This, of course, helps reduce failures caused by overstressing seats, stems and other working parts.

Because of its hardness, Monel can substantially reduce damage caused by turbulence, flow erosion and particle abrasion. Being rustproof and corrosion-resisting, Monel can greatly extend the life of valves operated under severely corrosive conditions. And its good heat-resisting qualities permit the use of Monel in service up to 750°F.

Leading valve manufacturers stock Monel-trimmed valves for all power plant applications. Ask about these valves. They're designed to give you extra long life with a minimum of maintenance. And write us for a helpful booklet that shows how you can save money on valves used for many kinds of difficult service. Just ask for a copy of "Trimming Valve Costs with Lasting Trim."

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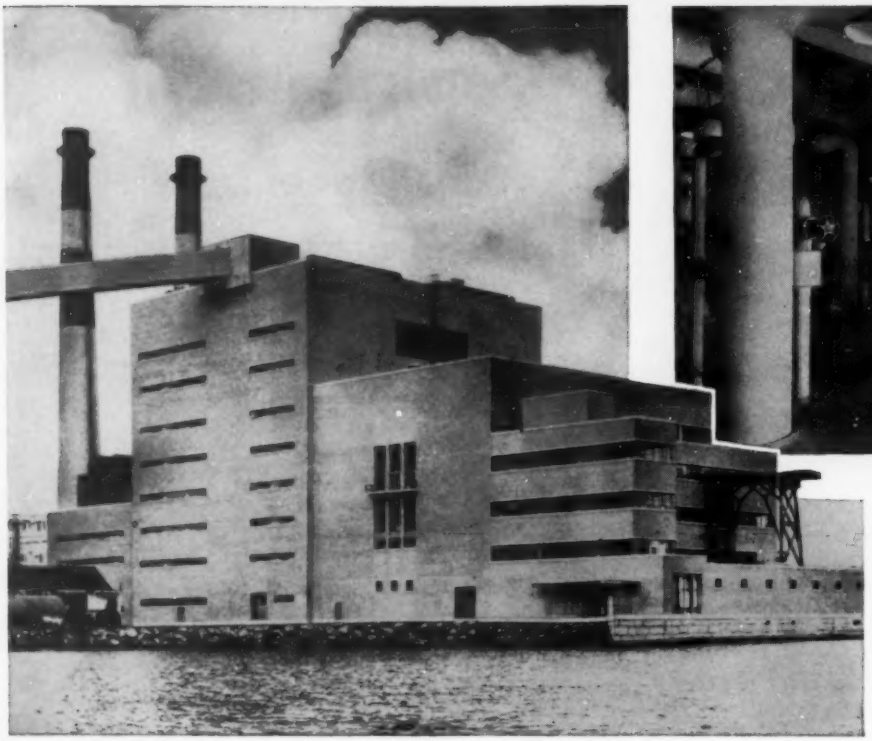
More POWER for you . . . with MONEL

INCO TRADE MARK **NICKEL ALLOYS**

New England's most modern Power Station used 25 miles of National Seamless Pipe



A VIEW OF the boiler feed pump discharge piping which feeds the water heaters in turbo-generator Unit #1. Further uses for NATIONAL Seamless in this plant are: Bleeder Steam Suction, Condensate, Heater Drain and Vents, City Water and Fire Protection, Oil Piping, Soot Blower and Boiler Blow Down.

OVER 700 tons of U·S·S NATIONAL Seamless Pipe and Tubes, ranging from ¾" ID to 18" OD, were used in constructing this $30,000,000 power station at Salem Harbor, Massachusetts.

Construction of the Salem Harbor Station of New England Electric System was begun in December, 1948. The first of the huge turbo-generators went into operation in late 1951. The completion of the second unit gave the plant a capacity of 150,000 kilowatts and a combined annual output of more than 1,000,000,000 kilowatt hours.

The boilers operate on oil or coal. Steam for conversion to power is generated at 1450 psi pressure and 1000°F. temperature. To condense the steam, the plant uses 175,000 gallons of ocean water *per minute* or 250,000,000 gallons per day!

This type of grueling service demands the best in power plant piping. U·S·S NATIONAL Seamless has never been surpassed for power plant service, even under the most severe operating conditions. Because they are pierced from solid billets of steel, NATIONAL Seamless Pipe and Tubes have the strength, uniformity, and dependability of solid forgings—remain structurally sound under high temperatures and intense pressures.

For further information on NATIONAL Seamless applications in power plants, write for free Bulletins 10 and 26. And when you're planning a new plant or repiping a present installation, play it safe with NATIONAL Seamless.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

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FOR ALL THESE MODELS

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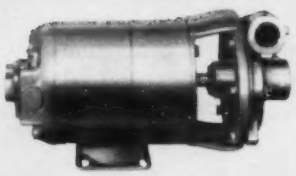
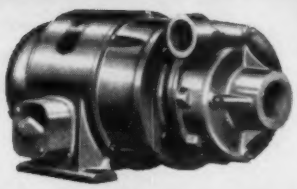
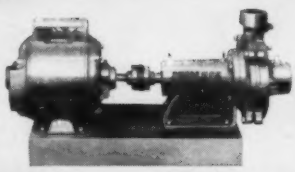


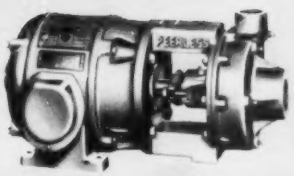
2, 3, 5 hp FACEMOUNT



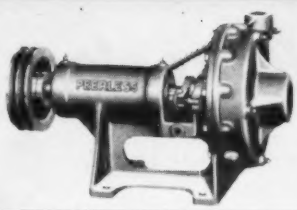
FLEXIBLE-COUPLED Fractional hp



5-50 hp DIRECT CONNECTED



FLEXIBLE-COUPLED Integral hp



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PEERLESS PUMPS

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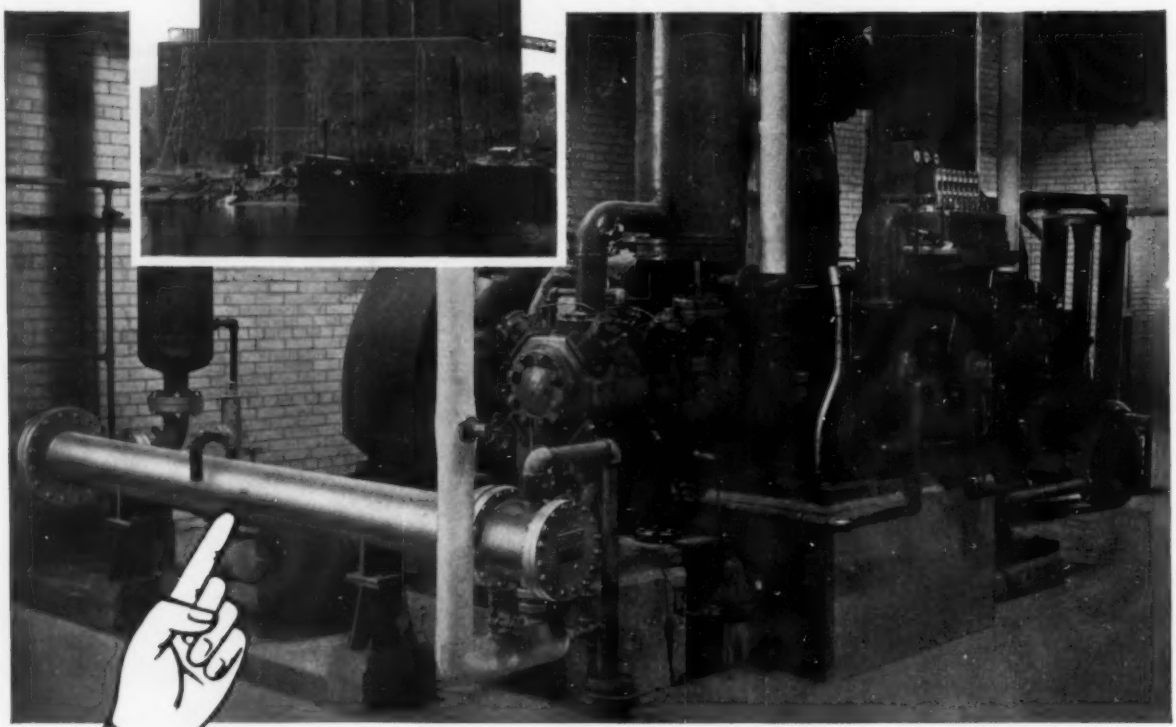
Air compressors in soot blowing service at this new Niagara Mohawk Power Plant



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Cooling and drying compressed air for soot blowing service in Niagara Mohawk Power Corporation's new steam electric station, south of Albany, N. Y., are several Ross Aftercoolers. Each serves a motor driven compressor.

The use of Ross Aftercoolers like the one shown, or the smaller pipeline types complete with moisture separators, is widespread. Availability of standardized designs and sizes to meet a wide range of conditions is a major reason. Space-saving compactness is another. Rugged construction and enduring materials are still another.

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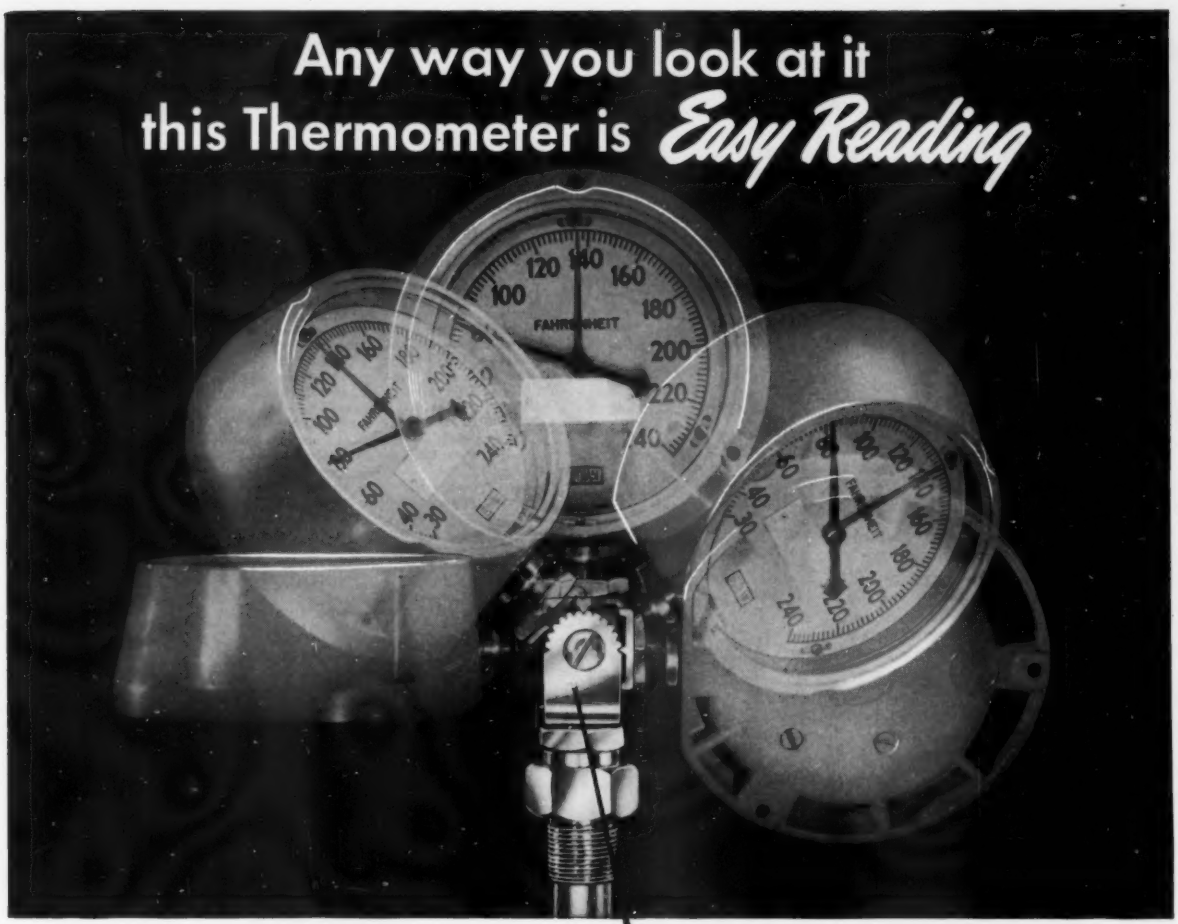

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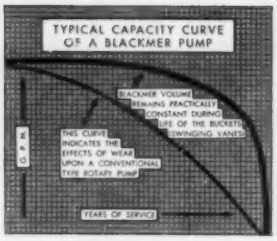
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GPM
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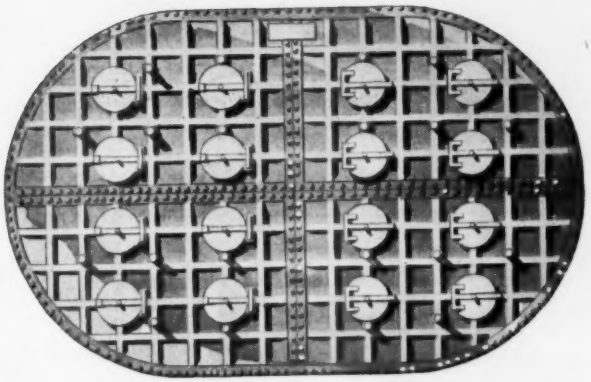

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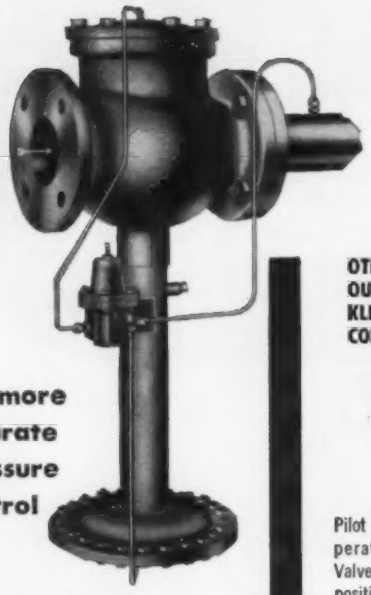

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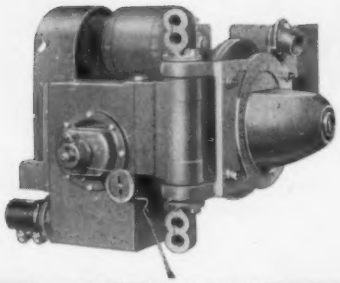

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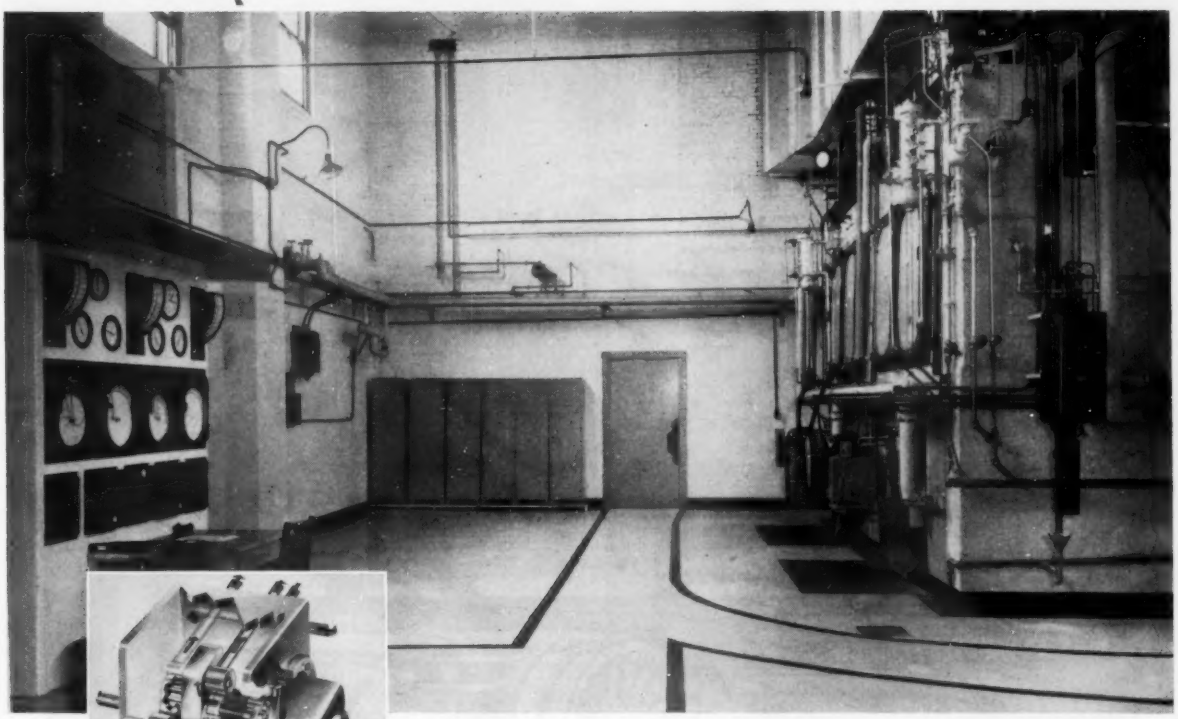

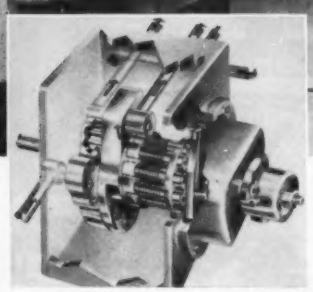

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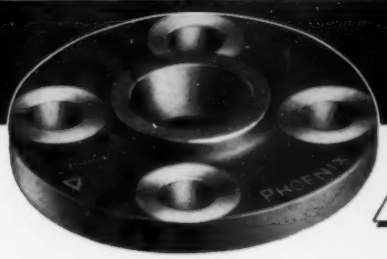

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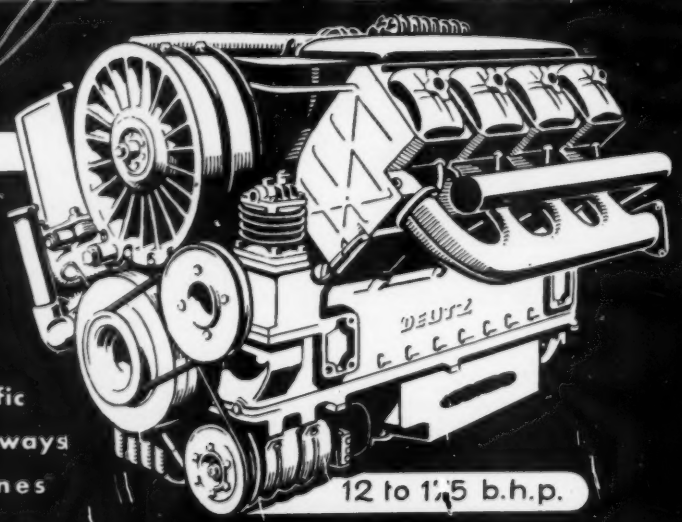

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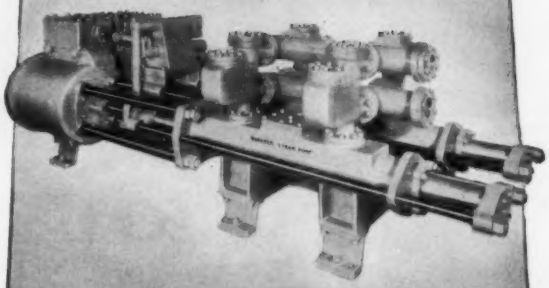

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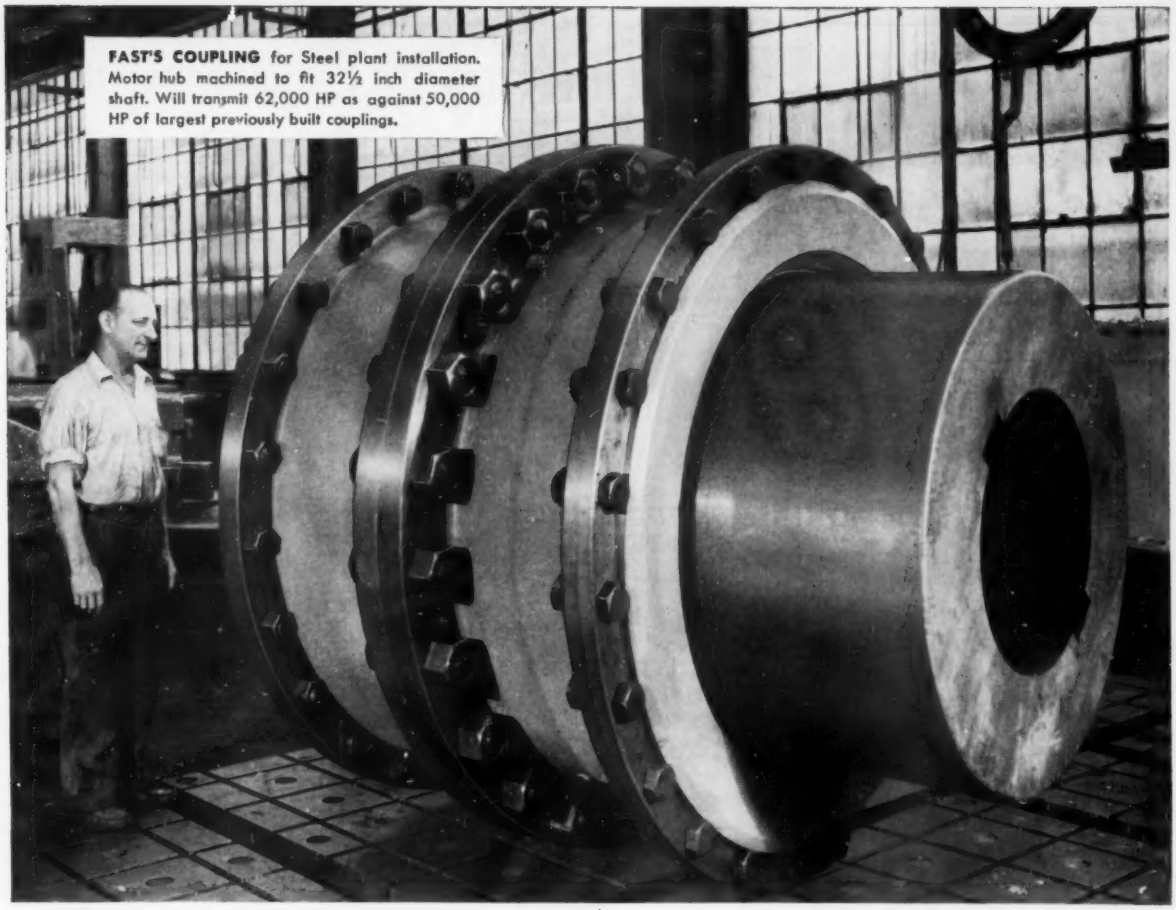

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It will transmit power from an electric motor to the equipment, and, at the same time, compensate for shaft misalignment and lateral float, give maximum power transmission efficiency, eliminate breakdowns and costly down-time.

WHAT'S YOUR COUPLING PROBLEM?

This mammoth Fast's Coupling is just one example of the outstanding jobs which Koppers is equipped to handle. 35 years of manufacturing "know-how" go into the production of *all* Fast's Couplings, large and small alike. Engineering specialists, experienced in designing Fast's Couplings for special applications, are well equipped to solve your coupling problems.

Remember, there's a Fast's Coupling for every power transmission application. Next time you have a coupling problem, call on Koppers . . . always ready to serve you. No obligation, of course. Also, for full details on Fast's Couplings for industry, mail this coupon.

THE ORIGINAL **FAST'S Couplings**

KOPPERS®

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

Engineered Products Sold with *Service*

KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* **226 Scott St., Baltimore 3, Md.**

Gentlemen: Send me FREE, Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

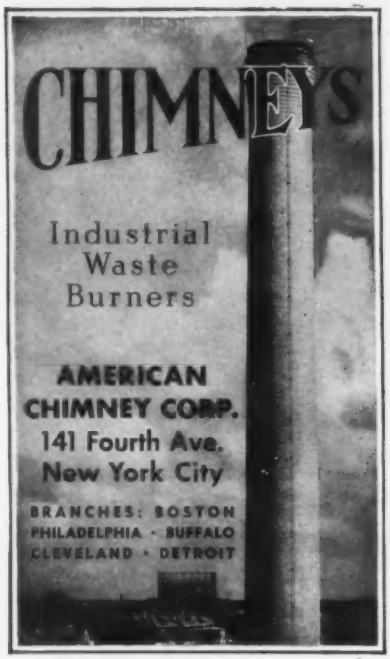
Company .....

Address .....

City ..... Zone ..... State .....

WHERE TO BUY

Featuring additional products, specialties & services for power plants



STOP *that* WATER

With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.
HAYNES PRODUCTS CO., OMAHA 3, NEBR.

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers—The readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

Classified Advertising
POWER

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AMERICAN HYDROTHERM CORP.
Thermal Engineers
HIGH TEMPERATURE WATER SYSTEMS FOR DISTRICT AND INDUSTRIAL HEATING
Universities, Hospitals, Military Bases, Housing Projects; Plant Process and Space Heating; also Power Generating Plants with Heat Distribution Requirements.
33-70 12th Street, Long Island City 6, New York

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
4706 Broadway Kansas City 12, Missouri

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Consulting and Designing Engineers
Kansas City, Mo. P. O. Box 7088
Cleveland, Ohio 1404 E. 9th St.

GILBERT ASSOCIATES, INC.
Engineers • Consultants • Constructors
Reading, Pa.
Engineering and Design • Construction Supervision
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INTERNATIONAL ENGINEERING COMPANY, INC.
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74 New Montgomery St., San Francisco 5, Calif.

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
Power Plant Specialists
Utility — Industrial — Chemical
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Engineering and Architectural Consultants and Designers
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PUMPING PLANTS—ELECTRIC SYSTEMS
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Power Plants Consultations
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Greenville South Carolina

STANLEY ENGINEERING COMPANY
Consulting Engineers
Power Plants
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SYSKA & HENNESSY, INC.
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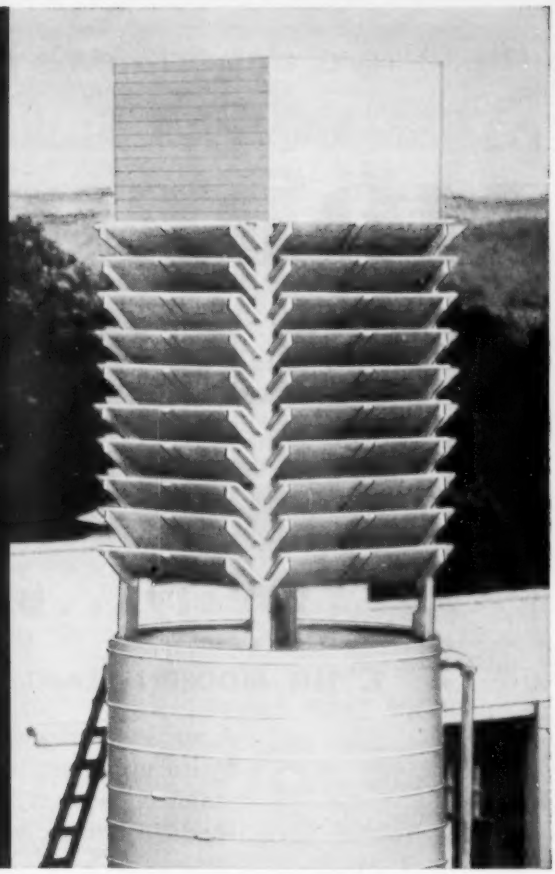
Consultation Plans Reports
Power Plants Disposal Plants
Water Systems
114 East 39th Street
New York, New York

WATER SERVICE LABORATORIES, INC.
Specializing Since 1927
Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
New York—Philadelphia—Washington, D. C.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

MOGUL

...Kills and Removes Algae from Cooling Systems ...Without Costly Shut Downs



You no longer have to put up with expensive, time-wasting shut-downs for manual cleaning of algae-congested cooling systems. No more algae-clogged strainers, impeller pumps, lines and nozzles. Mogul has developed a proven, practical way to remove and prevent formation of algae in cooling systems that's simple and inexpensive to use.

Mogul Algicide effectively kills the plant organisms that develop in water from air and water borne spores. Prevents new growth as long as it is used. The dead algae precipitates to points where it may be easily removed without shutting down the system.

If you are operating a water cooling system that is plagued with slime and congestion, find out about Mogul Algicide. It is low cost, harmless to water systems and is *guaranteed* to remove and prevent algae congestion when used as recommended. Use the handy coupon to send for Mogul's new bulletin telling how to eliminate the problem of algae from cooling water systems.

The North American
MOGUL
Products Company
Cleveland 13, Ohio

Memo to:

The North American Mogul Products Company
Cleveland 13, Ohio

Send me your latest bulletin "Mogul Algicide"

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

These five departments make

POWER'S

MODERN PLANT HANDBOOK

timely . . . useful . . . lasting

1. THE MODERN PLANT SURVEY

A survey of more than 500 new generating plants, both steam and hydro, utility and industrial. Tabulated data on capacity, design trends, major equipment. Includes projects completed, in construction, and specified but not yet started.

2. POWER AWARDS FOR MODERNIZATION

Careful documentations of actual modernization programs, with problems, solutions and results, supplied by engineer readers.

3. THE DIRECTORY FOR MODERNIZATION

A complete diectory of power-field equipment. More than 600 product listings and more than 1200 manufacturers, with their addresses.

4. CROSS-FILE OF OBSOLESCENCE

Names of former manufacturers of power-field equipment, matched with current name of successor company. Especially useful in any general campaign of modernization where obsolete equipment is being replaced or renewed.

5. THE SHOW CASE

Selected new products with full description and details for tie-in with modernization plans. Name of manufacturer in every case, plus double order card for reader's use in getting more detailed information.

It's coming September 15 — You'll want to file it and refer to it throughout the year

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

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$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)

POSITION WANTED undisplayed rate is one-half of above rate, payable in advance.

PROPOSALS, $1.50 cents a line an insertion.

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DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED or FOR SALE Advertisements acceptable only in Displayed Style.

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The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches —to a page. PR.

NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the July issue closing June 10th

IMPORTANT TEACHING POSITIONS OPEN IN ISRAEL

Technion, Israel Institute of Technology, in Haifa, Israel, proposes to appoint:

Professor of Mechanical Engineering

Professor of Mechanical Engineering, with special qualifications in machines and Applied Thermodynamics

Professor of Electrical Power Engineering

Applicants should have first-rate professional and academic qualifications, be willing to integrate themselves into the life of the country and, in due course, to teach in Hebrew.

Applications with full details should be sent in duplicate, for transmission to Haifa, to the:

AMERICAN TECHNION SOCIETY
1000 Fifth Ave., New York 28, N. Y.

CHIEF STEAM ENGINEER

Wanted for large modern industrial steam plant in British Columbia. Man with good experience required. Reply, giving full particulars to

P-2722, POWER
68 Post St., San Francisco 4, Calif.

WATER CHEMIST RESEARCH AND DEVELOPMENT DIRECTOR

Large Northern New Jersey chemical company seeking a development research director for its industrial water treatment division. Background in boiler water and cooling water treatment required. Applications will be treated in strictest confidence.

P-2622, POWER
330 W. 42 St., New York 36, N. Y.

***When Answering* BOX NUMBERS . . .**

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

Selling Opportunity Offered * Sales Engineers

We are a nationally established concern that constructs and repairs chimneys and incinerators. Earning potentiality is high for an alert representative organization. If interested, please write full particulars as to: territory covered, industrial fields contacted, etc. Replies held in strictest confidence.

RW-2788, POWER
330 W. 42 St., New York 36, N. Y.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

DESIGN AND Application engineer Regulation and Control Valves. Must have thorough knowledge fluid flow and extensive application experience, possibly in instrument department of large process operation. This is an attractive position with a small manufacturer in Midwest. Salary $8,000 plus bonus. P-2562, Power.

SELLING OPPORTUNITY OFFERED

WANTED—SALES Engineers, openings in several territories for experienced Sales Engineers representing a large producer of Boiler Water Treating Compounds. Excellent opportunities for men who can qualify for sales and service contacting Power Plant Engineers and Firemen. All replies will be kept confidential. For complete details write to Starr Mfg. & Chemical Company. P.O. Box 383, Lima, Ohio.

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

POSITIONS WANTED

STEAM POWER PLANT Superintendent with nine years experience operating oil and coal fired boilers and generating equipment. Technical education. Age 33. PW-2350, Power.

EXPERIENCED SWITHCBOARD Operator would like operating job in central or substation. PW-9867, Power.

LOS ANGELES—Sales Engr-Mgr. M.E. Exper. power plant equip. contacting West Coast A&E's, contractors, industries, utilities, desires position with mfr, contractor, other concern req. rpr. on West Coast from L.A. Salary & incentive. PW-2756, Power.

POWER PLANT Engineer M.E. 20 yrs broad power and mechanical experience—power, metallurgic, process plants—supervision, design, construction, maintenance, operation. Prefer varied engineering or supervision—smaller industrial plant with power plant. PW-2718, Power.

SELLING OPPORTUNITY WANTED

MINNESOTA COMPANY, Well established and adequately financed, with warehouse and trackage facilities, is interested in obtaining distributorship for State of Minnesota and adjoining states, on products sold to the industrial trade. RA-2549, Power.

WANTED

ANYTHING within reason that is wanted in the field of Power quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

Equipment Wanted — page 313

HELP WANTED

Superintendent, Municipal Power Plant. Electrical or Mechanical Engineer with administrative experience preferred. Total plant installed capacity 21,000 KW. Near Chicago area. Hard Work with problems but good opportunity for right man.

Send full particulars of education, experience and salary with first application.

P-2464, POWER
520 N. Michigan Ave., Chicago 11, Ill.

POWER PLANT ENGINEER

With mechanical engineering degree and capable of taking full charge of plant producing 150,000 pounds of steam per hour at 500 pounds pressure. Ability to design, install and maintain boiler equipment. Know boiler water treatment. Salary commensurate with experience and background. Send complete information on educational and experience background.

P-2688, POWER
330 W. 42nd St., New York 36, N. Y.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

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There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all RE-MANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

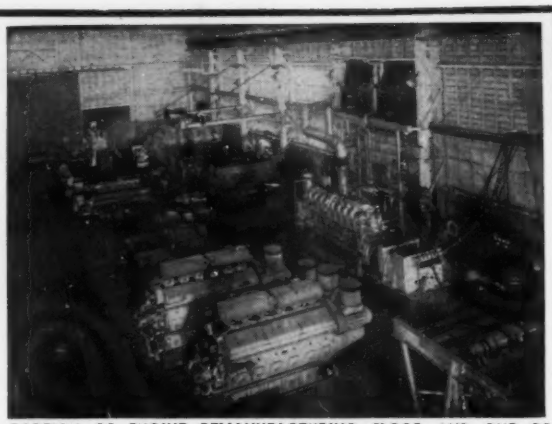
America's largest source of New and Remanufactured Diesel Power

A.G.

SCHOONMAKER CO., INC.

50 CHURCH ST., NEW YORK 7, N. Y.

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA
TELEPHONE — DIGBY 9-4350 • TELETYPE — NY 1-2804
W. U. WIRE • CABLE — AGSCOMACH



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
600	General Motors	12-567	900	600
*500	General Motors	8-278A	750	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*400	Ingersoll-Rand	S-8	600	720
*400	Sterling	VDS-8	600	1200
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
150	Fairbanks Morse	338-17	225	300
*150	Worthington	CC-4	225	450
150	Ingersoll-Rand	S	255	600
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED
*—indicates NEW unit

ONE YEAR GUARANTEE!

BOILERS

12—304 HP Kewanee Firebox Boilers, Model 590, 125 PSI, with oil burners & soot blowers, ASME.

4—150 HP, HRT Boilers, 150 PSI, gas fired, ASME.

GENERATOR SET

1—300 KW, GMC 8-268A Diesel, portable, radiator cooled, 1200 RPM, 3/60/440.

PHONE — WIRE — WRITE

HEAT & POWER CO., INC.
70 Pine St., New York 5, N. Y.
HANOVER 2-4890

BOILERS

Bought • Sold • Rented

3—202 H.P.—250 Lb. Scotch Marine Type Eternal Dutch Oven Fired Walsh-Widener Boilers

Cyclotherm 50 H.P. 125 Lb. Heavy Oil

750 Deg.—1,600,000 B.T.U.—125 Lb. International-Dowtherm Boiler

2—25 H.P. Ames Package Units 1949-1951—Gas or Light Oil 8000 Gal. Cement Lined Hot Water Tank

50 H.P.—150 Lb. Steamaster

BOILER & EQUIPMENT CO.
743 Bedford Ave. Brooklyn 5, N. Y.
ULster 5-3588

1000 KW DIESEL GEN. SET

6 Cylinder, Air Start, Bosch Inj. System, Nelesco Diesel Engine, 300 RPM, direct coupled to: General Electric AC, 1000 KW, 3/60/2400 Volts, including: Starting Auxiliaries, Switchboard, and Spare Parts. Overhauled, ready to ship.

Various other makes and sizes in stock, AC & DC Units.

ALJON ELECTRIC DIESEL CO.
904-10 Pacific St. Brooklyn 38, N. Y.
STerling 3-6515

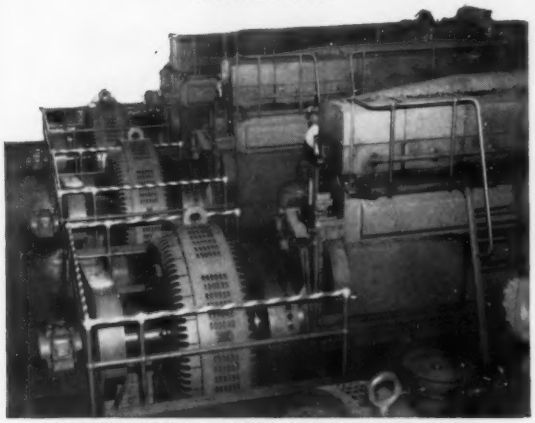
Your Portable Generator Headquarters
- DIESEL - - GASOLINE -
1 to 1000 KW, AC & DC
RENTAL • SALES • PURCHASES
Midwest Utilities Power Equipment Corp.
1270 W. Augusta Blvd. Chicago 22, Illinois
Everglade 4-4511

Special Offering

4240 KW DIESEL GENERATOR PLANT

HEAVY DUTY • SLOW SPEED • MODERN DESIGN

(ACTUAL PHOTO)



WORTHINGTON MODEL SEH-8 DIESEL UNITS

LATEST TYPE—CURRENT MODEL PRACTICALLY NEW

CAN BE INSPECTED AND TEST RUN . . . CONVERTIBLE FOR DUAL FUEL OPERATION . . . WILL BURN HEAVY FUELS . . . ONE YEAR GUARANTEE

3—1180 KW WORTHINGTON MODEL SEH-8 DIESEL UNITS

ENGINES: Each rated 1685 BHP at 360 RPM turbocharged having 8 cylinders arranged vertically in-line, 16" bore, 20" stroke, 4 cycle, solid injection.

GENERATORS: Westinghouse each rated 1180 KW, 1475 KVA for 2400/4160 or 480 Volts, 3 phase, 60 cycle service.

SWITCHGEAR: Metal-clad type manufactured by Westinghouse with draw-out type air circuit breaker.

50 CYCLE RATING 984 KW AT 300 RPM

UNIT AUXILIARIES: Each unit complete with filters, strainers, pumps, gauge board, pyrometer, thermocouples, lube oil cooler, jacket water cooler, cooling tower, exhaust muffler, intake filter silencer, expansion tank, fuel day tank, flexible piping for intake and exhaust and all station piping, flanges, valves, gauges and fittings for intake, exhaust, water, lube oil and fuel oil systems.

ALSO

1—700 KW Worthington diesel unit with same auxiliaries and accessories as above.

This equipment affords you a rare opportunity to procure complete, modern, latest design diesel units at substantial savings. It represents an offering of heavy duty slow speed diesels which cannot be duplicated by anyone in the diesel field.

ACT TODAY—PHONE, WIRE, OR WRITE FOR FULL DETAILS

Other Modern Diesel Sets from 2000 KW to 15 KW in STOCK—All Owned and Offered Exclusively by "America's Largest Source of New and Remanufactured Diesel Power"

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

ESTABLISHED 1898

Diesel Engines • Power Machinery

50 CHURCH STREET, NEW YORK 7, N. Y. PHONE DIgby 9-4350

PLANTS AT EDDYSTONE, PA., JERSEY CITY, N. J., SAUSALITO (S.F.), CAL.

DIESEL GENERATOR SETS

3—650 HP Alco 6 cyl. 514 RPM supercharged. 400 KVA 3/60/440 volts. Complete plant. New 1943.

3—300 HP Buckeye 6 cyl. 600 RPM 4 cycle. 200 KW Ideal 3/60/480 volts generators. Complete plant. New 1947.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

1—2000 KVA — 3-60-33000-4160Y Westinghouse type CPS Westinghouse self-contained substation.

1—450 KVA—3-60-13200-115/230 V. GE substation.

4—100 KVA—3-60-2400-208/120 V pyranol GE transformers with 225 A3 pole airbreaker mounted on case.

700 & 450 HP—180 rpm—4160 V UNUSED syn. motors.

H. BLAINE JOHNSON & ASSOCIATES
53 W. Jackson Blvd., Chicago 4, Ill.

ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
500(3)	1800	West	Syn. 2200 V.	PedBrgW/Exc
450	1800	AC	SC 2200 V.	AW-SB
350	1800	AC	SC 2200 V.	AW-SB
300	1800	West	SC	CS-TEFC Exp. Pr.
150(2)	900	GE	SC 2200V	KF-558
150	1800	GE	SR	M-6328 TEFC
150	720	Al-Ch.	SR	AR HOIST
150	750	GE	SR (25 cy)	IM
125	1200	AC	SR	ARY-BB
125(3)	900	West	SC 2200V	CS-856-C
100	720	West	SR	CW-513
100	900	GE	SR	MT-SB
100	700	West	SC	CS-SSB
100	725	Al-Ch.	SR (25 cy.)	ARY-3 Brg.
100	900	GE	Syn 2200 V.	TS-DC Exciter
75	3600	GE	SC	K-444-8
75	900	West	SR	CW-725C
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	West.	SC	C8505 Spl. Pr.
60(3)	1200	Al-Ch.	SR	ARY-505 BB
60	720	West	SC	C8754 Spl. Pr.
50	1800	FM	SR	HV-BB
50	1200	GE	SR	MT-336
50	720	CW	SC	SC
50	600	CW	SR	SR
40(2)	1200	Rel&West	SC	Fr. 445-RB
40(2)	1200	AC&Rel	SC	TEFC-BB
40	900	West	SR	CW
40	720	AC	SR	ANY
30(3)	1800	AC	SC	ARZ-TEFC
30	1200	AC	SC	ARZ-TEFC

SPECIALS

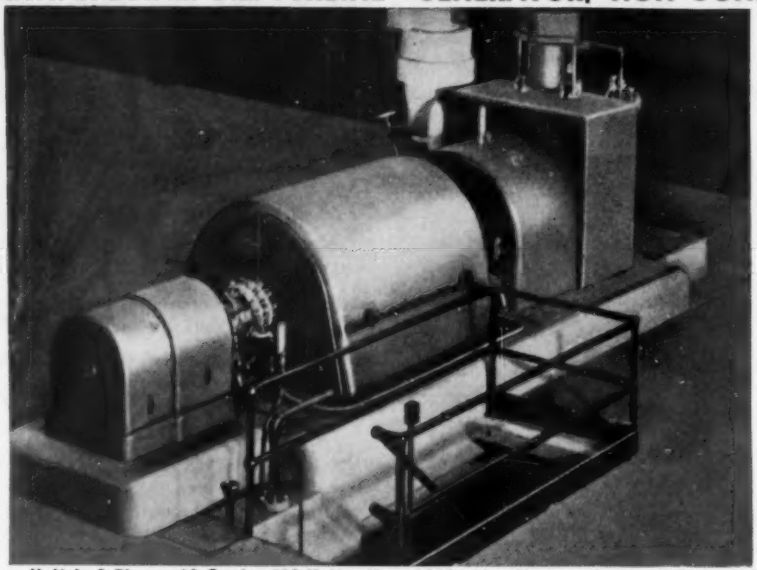
2—333 KVA Penn. Transformers OISC 1/60—13800/2300.
1—500 KVA Trans. West'hse Type ASL, 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

NATIONAL ELECTRIC SERVICE CO.

321 Lombard St., St. Louis 2, Mo. Phone — Chestnut 1-4603

500 K.W.: SPECIAL: G.E. TURBINE—GENERATOR, NON-CONDENSING

Modern Machine GOOD FOR 400# psig. With Changes



WRITE TODAY FOR COMPLETE DATA & DRAWINGS

Above Unit is 3-Phase, 60-Cycle, 480-Volts: New 1946. Also Non-cond. Any Unit to 2500-V. Cond. 300 to 12500-KW. Diesel Power, Boilers: Complete Lines in Stock.

CHARLES WEAVER

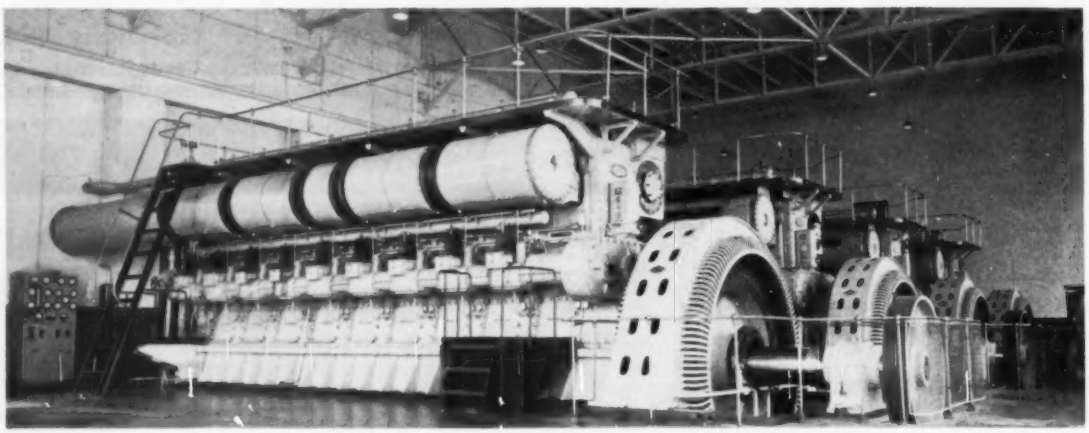
TURBINES-BOILERS
DIESEL ENGINES...

ELECTRICAL—MECHANICAL ENGINEERS
4145 PENOBSCOT BLDG., DETROIT 26, MICH.

PHONE
WO. 1-1340

FOR SALE—DIESEL ENGINES

4 Busch-Sulzer like new, 2160 K.W., 3060 BHP, 240 RPM, directly connected to 4 Generators, 2700 KVA, 3 phase, 60 cycle, complete with Exciters, all Auxiliaries & Accessories. Can be operated for inspection.



WRITE — WIRE — PHONE

M. S. KAPLAN COMPANY

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REBUILT—GUARANTEED ELECTRICAL EQUIPMENT

DIRECT CURRENT MOTORS
230-V. D.C.

Qu.	HP	Make	Type	RPM
6*	3000	Whse.	Mill	600
14*	1500	Whse.	Mill	600
10*	800	Whse.	Mill	600
8	700	Whse.	Mill	285/700
1	350	G. E.	CD-169	1150
1	250	G. E.	MPC	325/975
1	200 '250	G. E.	MPC	300 '900
1	200/250	El. Dy.	Size 22	400/1200
1	200	Whse.	Mill	300/1200
1	180	G. E.	MPC	400
1	160/90	G. E.	MPC	625/1125
1*	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
6	100	El. Dy.	30-S	450/1100
6	75	C.W.	55 H	860
1	50	Whse.	SK	250/1000
1	40	Whse.	SK-140	500/1700
1	35	G. E.	CD-125	400/1200
1	35	G. E.	CD-147	300/1200

*—525 and 600 V. D.C.

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1 (3U)	2400	Whse.	720	600	4800/2400
2	1750	G. E.	450	250	4600/2300
2	1200	Whse.	720	600	2300
2	1000	G. E.	900	600	13200/6600
2	500	C. W.	720	575	2300/440
1	400	C. W.	1200	125/250	2300/440
1	400	C. W.	720	250	2300/440
1	300	Whse.	900	250	2300
1	150	G. E.	720	250	2300/440
1	100	Ridgway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	100	Whse.	900	250	2300

SLIP RING MOTORS
Constant Duty 3 phase 60 cycle

Qu.	HP	Make	Type	Volts	RPM
1**	1800	G. E.	MT-498	2300	357
1**	1200	G. E.	MT-26	2200	277
1	700	G. E.	I-M	2300	400
1*	600	G. E.	MT-20	2300	360
1**	500	Al. Ch.	ANY	2200	514
2	500	G. E.	I-16-M	2300	450
2	400	G. E.	MT-412	2200	450
1	300	G. E.	I-M	2200	600
1	250	Whse.	CW-937	440	1200
1	250	G. E.	MT-414	2200	300
1	250	Al. Ch.	ARY	440	720
2	100	G. E.	I-15-M	2300	514

**Pedestal bearing design

SQUIRREL CAGE MOTORS
3 phase 60 cycle

Qu.	HP	Make	Type	Volts	RPM
1	400	G. E.	IK	2300	514
1	300	Whse.	CS 890	2300	1750
1	200	Al. Ch.	A.R.	440/220	580
1	200	Whse.	CS 873 C	2200	1160
2	125	Al. Ch.	A.R.	2300	1750
1	125	Al. Ch.	A.R.	2300	490
1	100	G. E.	KT 562	440/220	570
1	100	Whse.	CS 938	2200	495

SYNCHRONOUS MOTORS
3 phase 60 cycle

Qu.	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
2	2100	G. E.	100	2300	360
2	2000	G. E.	80	2300	720
2	1750	G. E.	100	2200	3600
1	750	G. E.	80	2300	450
1	710	G. E.	80	2300/440	720
1	250	G. E.	100	2300	514
1	250	G. E.	80	2300	600
2	200	Whse.	80	440/220	1200
1	187	G. E.	80	440/220	720
1	150	G. E.	100	2200	900
1	150	G. E.	80	440/220	450
2	135	G. E.	80	4000/2200	1200
1	125	G. E.	80	2200	900
2	100	Whse.	80	440	1800
2	100	G. E.	80	440/220	600

TRANSFORMERS
60 Cycle

Qu.	KVA	Make	Phase	Voltage
3	750	Pitts.	1	23,000-2300
3	667	Wagner	1	22,000/11,000-2300/4000
3	500	G. E.	1	22,000/11,000-2300/4000
3	150	Al. Ch.	1	4160/7200-240/480
3	100	G. E.	1	33,000-2300
3	25	G. E.	1	2400-120/240
42	3	Al. Ch.	1	2400-120/240

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450 HP 160# Package Boiler—1951
200 HP 200# Package Boiler—1953
160 HP 125# Package Boiler—1951
30 HP 1952 Clayton Package Boiler
500 KW Unaflow Engine Generator Set
1000 KW Synchronous Motor Gen. Set
BRAND NEW Chemical Equipment—all kinds

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"Certified Rebuilt" Motors and Generators
HIGHEST QUALITY . . . REDUCED PRICES
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A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4060/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis Ch.	1 brg.	480	400
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec.	ATB	2300	900
150	Whse.		2300/480	600
125	El. Machy.	Syn.	240/480	1800
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200
25	Whse. b.b.	1 phase	120/240	900

LOW VOLTAGE M-G SETS—2
Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	250	1200
250	Gen. Elec.	MPC	250	600
200	Gen. Elec.	RC	250	1150
150	Gen. Elec. b.b.	CDM	250	1500
105	Century b.b.	1500 amp.	70	1200
100	Allis Ch.	E	125	1200
100	Allis Ch.	E182	250	900
100	Delco b.b.	Mar.	125/250	1200
75	F. M. b.b.	DH	125	1800
75	G. E. b.b. (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Columbia b.b.		120/240	1450
60	Allis Ch.	E147	250	900
60	Whse. b.b. (2)	SK121	300	1200
50	Cr. Wh. b.b.	CCD	250	1800
50	Reliance	T	250	1150
50	Allis Ch.	EW	125/250	1200
40	Gen. Elec.	CD103	250	1500
40	F. Morse b.b.	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
25	C. W. b.b. (2)	CCD	250	1200
20	Gen. Elec.	RC	125	1150

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
750	Whse.	Synch.	2200/4000	900
700	G. E.	Synch.	2200	514
600	E. M.	Synch.	480	1200
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Silpring	2200/440	450
500	G. E.	Synch.	440	900
450	Allis Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis Ch.	Sq. Cage	2200/440	1200
350	G.E. Ex. Pr.	Sq. Cage	2200/440	3600
350	Whse.	Silpring	2200/440	600
350	Whse. (2)	Silpring	2300	450
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Silpring	2300	514
300	G. E.	Silpring	440	360
250	G. E.	Sq. Cage	220/440	450
250	G. E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Allis Ch.	Silpring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse	Sq. Cage	2200/440	900
200	G. E.	Silpring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Silpring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	E. M.	Synch.	220/440	514
200	Wagner	TEFC	2200	1200
175	G. E. (2)	Synch.	220/440	720
175	Whse.	Synch.	220/440	360
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Silpring	2200/440	720
150	G. E.	Synch.	220/440	450
150	Allis Ch.	Silpring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Silpring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Silpring	2200/440	600
125	G. E.	Silpring	220/440	450
125	E. M. (2)	Synch.	220/440	1800
125	Allis Ch.	Silpring	220/440	900
100	G. E. TEFC	Sq. Cage	220/440	1200
100	G. E.	Silpring	220/440	900

48 Years of Service to American Industry

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
250	Gen. Elec.	LDR	250	450/850
200	G. E. (2)	RC59	230	850
150	Whse.	SK-201	230	300/900
100	Whse.	SK183	230	450/1200
100	Allis Ch.	E182	230	600/1200
75	F. Morse b.b.	DH140	115	1600
75	Whse.	SK170	230	635
50	Whse.	SK173	230	300/1200
60/75	Gen. Elec.	C	230	500/1200
50	Reliance	310T	230	850
50	Reliance b.b.	651T	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Cr. Wh. b.b.	FH	230	1750
50	Whse.	SK183	230	300/900
40	Whse.	SK143	230	600/1500
40	Reliance	651T	230	350/1000
40	Allis Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	Star b.b.	SB	230	1750
25	L. A. TEFC	RNA	230	850
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD105	230	575/1720
20	G. E. series	CO-1826	230	875

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	G. E.*	440 AC	250 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
250	Allis Ch.	2200/440 AC	350 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G. E.*	220/440 AC	250 DC
200	Gen. Elec*	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
105	Century b.b.	220/440 AC	70 DC
100	Al. Ch.	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	125/250 DC
80	Star* b.b.	220/440 AC	240 DC
60	Gen. Elec.*	220/440 AC	60 DC
60	Whse. (2)	220/440 AC	300 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Allis Ch.	220/440 AC	125/250 DC
50	Cr. Wh. b.b. (3)	220/440 AC	240 DC
40	G. E. (2)	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	600 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec	220/440 AC	250 DC
20	Star b.b.	220/440 AC	120 DC
16	Gen. Elec.	220/440 AC	125 DC
15	El. Prod.	220/440 AC	40 DC

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MOTORS • GENERATORS • TRANSFORMERS

3 PHASE 60 CYCLE 220/440 VOLT

HP	Make	Type	Speed
10	F.M., 2 Speed	H-128	600/1200
10	G.E.	KT-502	860
10	Cr. Wh., BB	SC-ALH 365	865
10	Allis Ch.	AR	1200
10	G.E.	KT-390	1200
10	G.E.	K-326	1200
15	West. New, Vert., BB	CW-404	900
15	G.E.	IK	700
15	G.E.	KT-312	900
15	G.E.	K-512	900
15	Cr. Wh.	SC	900
15	U.S., BB	FRB-482	1200
15	Reliance	IH	1200
15	G.E.	K-326	1800
15	L. Allis, TEFCCB, Ex. Pr.	EX-364	1760
15	G.E., Special	KF	3480
15	G.E., Var. Speed	IK	1800/600
20	West.	MS	900
20	G.E.	I	900
20	Wagner	BP-18T	1140
20	West.	CS	1150
20	West., New, BB	CS-365	1170
20	L. Allis, TEFCBB, Ex. Pr.	ES-365	1800
25	G.E., Slip Ring	I-M	685
25	G.E., New	K-405	900
25	G.E.	IK	1200
25	Allis Ch.	AR	3600
30	Wagner, Slip Ring		1200
30	G.E., Slip Ring	MT-523	1800
35	West., Slip Ring	CW-785	585
40	Cr. Wh.	1210	685
40	Lincoln	IM	720
40	West.	CS	1160
50	West.	CS	900
50	G.E.	K-504	1200
50	F. Morse	12-B	1725
50	F. Morse	H	1750
50	Ideal, New, TEFCCB	A-B	1800
60	West., TEFCBB, Ex. Pr.	CS-607	875
75	West., Slip Ring	CW	900
75	G.E.	KT-356	865
75	F. Woischel, Synch.	26Y-RN	1200
100	West. Slip Ring	CW	435
150	G.E.	KT-5585	875
200	G.E., Slip Ring	IM	600
200	G.E., Synch	2300 volt	225
350	G.E., Synch	4800 volt	225

25 CYCLE MOTOR SPECIALS

1— 40 HP Reliance TEFC BB 3/25/220/440/1500 RPM.

1— 50 HP Fairbanks Morse BB 3/25/220/440/750 RPM.

1—100 HP Gen. Elect. Type KT 353 3/25/440/1445 RPM.

1—100 HP Gen Elect. Type KT 559S Ball Bearing 3/25/440/1465 RPM.

1—150 HP Gen. Elect. Type KT565 TEFC BB—3/25/440/750 RPM.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

400 HP GEAR REDUCER

1—400 HP Nutall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 H.P. COMPENSATOR

400 H.P. Westinghouse reduced voltage, manually operated synchronous motor starter—Unity P.F.—3/65/2300 Volts—Complete.

55" LIFTING MAGNET

1—55" Cutler Hammer Magnet 250 Volts DC. Excellent Condition.

125 VOLT DC MOTOR

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole
1—1600 AMP. Condit. 2 Pole
1—1600 AMP. Westinghouse 2 Pole
1—3000 AMP. Westinghouse 2 Pole

TRANSFORMERS

1—750 KVA Niagara, New. Outdoor 3/60/2400/208Y/120

1—300 KVA Niagara, New. Non-inflammable Liquid. 3 Phase, 60 Cycle 4160 V. Prim. 480 V. Secondary, Primary Fused Cutouts, Secondary Junction Box. Immediate Shipment

1—75 KVA G.E. Dry Type 1/60/440 V. Primary 220 V. Secondary

3—50 KVA Westinghouse Type C.S.P. 1/60/4160/7200Y—120/240

6—50 KVA Niagara. New. Dry Type 1/60/240/480-120/240

1—20 KVA G.E. Dry Type. 1/60/480 V. Primary, 120 V. Secondary

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

MOTORS • MG SETS

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
24	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	875 RPM
4	1250	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600/400/900	RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	220	250/500 RPM
1	400	G.E.	230	150/300 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	220	375/750 RPM
2	350	Cr. Wh.	220	400/800 RPM
1	200	Cr. Wh.	220	500/750 RPM
1	200	Cr. Wh.	220	375/750 RPM

All motors designed for mill reversing service.

Smaller sizes also in stock.

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100—2000 KW Capacity

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1—BABCOCK & WILCOX, Type FF-12 #28, 327 H.P. steam generator, 160 psig working pressure, complete with accessories.

1—WESTINGHOUSE moving grate single retort stoker with drive and spare parts.

1—GREEN cindertrap.

1—WING size 19 AEMD—7½ forced draft fan and two speed G.E. Motors.

1—COCHRANE, 25,000 lb. per hr. deaerating feedwater heater and storage tank (6,250 gal.).

2—PENNA. PUMP & COMPRESSOR, Type OMSB, 50 gpm boiler feed pumps, 360 ft. head. NPSH 8 ft.; one with motor drive and one with TERRY turbine drive complete.

1—LINK-BELT bucket elevator complete with drive.

1—UNITED CONVEYOR 6" steamatic ash conveying system.

All other necessary parts comprising a complete steam generating plant.

For complete description or to inspect this equipment contact

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36" bronze Chapman valves—30 pound pressure.

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Curtis 7-5050

GOOD HYDRO-ELECTRIC UNITS

1—312 KVA Westinghouse vert. ex on top 3-60-250V 600 RPM. Adj. blade Smith turbine & Woodward gov. panel—29' head.
1—240 KVA G.E. 3-60-2300V 225 RPM ex on top Leffel wheel 17' head.
1—144 KW G.E. vert. unit 3-60-240V 120 RPM with Smith wheel 8-10' head.
Several others, various sizes and heads of water.

WM. C. MOULTON ASSOC., Monson, Mass.

BRAND NEW WESTINGHOUSE TYPE OISC TRANSFORMERS

Quan.	KVA	Pri	Sec.	Cat. No.	Net $
2	3	4800/8320Y	120/240	2U5C — 201	45.00 ea.
1	5	2400/4160Y	120/240	3U3A — 201	50.00 ea.
2	7½	7200/1247Y	120/240	4C7C — 205	60.00 ea.
1	7½	4800/8320Y	120/240	4U5C — 201	60.00 ea.
2	10	7200/12470Y	120/240	5C7E — 205	75.00 ea.
2	10	2400/4160Y	120/240	5U3C — 201	75.00 ea.
2	15	7200/12470Y	120/240	6C7E — 205	90.00 ea.
2	25	4800/8320Y	120/240	7U5C — 201	110.00 ea.

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FOR SALE

MODERN 1000 KW Turbo-Generator

in excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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O'Brien Offers—

MOTOR GENERATOR SETS

2—800 KVA Alco-Buschsulder 240 DC or 3/60. Any voltage. 720 R.P.M.
1—300 KW Ridgway 250 V. 3/60/2300/1200 rpm
2—180 KW G.E. Frequency Changers 60/120 cycle
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—70 KW Century, 1000 amp, 70 volt, 3/60/220/440
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
1—18 KW Optimus, 3000/1500 amp 6/12 volt
1—17 KW West., 28 v. 60 amp 3/60/220
1—6 KW G.E. 6 v. 100 amp, 3/60/220

DIESEL GENERATOR SETS

2—800 KVA ALCO-Sulzer, 240 D.C. or 3/60 any voltage, 720 rpm
3—625 KVA Ingersoll Rand, 3/60/480/720 rpm
375 KVA GM 8-268 Diesel 3/60/440
300 KW GM 8-268 Diesel 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
125 KVA Waukesha Diesel 3/60/220-440
100 KW Buda Diesel 250 V. D.C.
100 KVA Murphy Diesel 3/60/220-440
65 KVA Buffalo Gas 3/60/220
56 KVA Climax Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
30 KVA LeRoi Gas 3/60/220
25 KVA LeRoi Gas 1/60/120/240
20 KW Hercules Gas 110 volt D.C.
18.75 KVA Hercules Diesel 1/60/120/240

BOILERS

1—25000# Foster Wheeler 250 Lb. W. T. Package Oil & Gas Comb. New
1—50,000# Erie Stoker New 160 psi
1—300 HP Keeler CP 300 lb. Oil
1—250 HP Ames Package type (1948) 150 psi oil fired
1—250 HP B & W 250 lb. 1948
2—200 HP Springfield Sec. Hdr. 400 psi.
1— 25 HP Dowtherm Vaporizer

ELECTRIC MOTORS

QU.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
3	3500	G.E.	IM	2300	120
1	350	G.E.	MT18	2300	400
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200

TURBO GENERATORS

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300.
New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 p.i 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi.
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr. Dr. 3/60/2300
2—660 cfm I R-XRE 3/60/480—100 psi
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—215 CFM Penna 3A, 70 psi—V-Belt
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7½x5x4, 100 psi
1—173 CFM Chicago NSB 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	West. (1945)	33,000	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	250	Al. Ch.	13,200	115/230	1
2	250	West. Dry	13800	230	1
3	150	West	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1
3	100	West.	4160	240/480	1
3—	75	West.	4160	120/240	1

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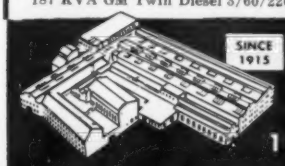

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L. D. (Long Distance) 65

ROCHESTER 1, NEW YORK

Explosion Proof Motor Headquarters

M-G SETS! MOTORS!

1—500 KW 24 V. D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200, Ser. 4979926 with magnetic reduced voltage starter.
1—200 KW, 125 V D.C., Type PED, Ser. 576881, E-M Set, 900 RPM, Syn. drive, 3/60/2360 (or 4160).

TURBO-GENERATOR

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/480. Elliott Turbine, inlet 200# ga., 112 deg. F superheat. 28" hg. vac. exhaust. Complete with accessories.

SYNCHRONOUS CONDENSER

1—1000 KVA, Allis-Chalmers, 3 phase, 60 cycle, 2300 volts, 600 RPM.

SYNCHRONOUS MOTORS

1—200 HP, F-M, 300 RPM, Type TZO, Frame 5
1—200 HP, E-M, 900 RPM, Type PED, 2300/4160 V
1—150 HP, G.E., 277 RPM, Type ATI, 2300 V

SQUIRREL CAGE MOTORS

Amt.	HP.	Speed	Make	Type	Frame
3	250	600	G. E.	KT568(2200V.)	
1	150	1800	Whse.	CS(2200V.)	8718
1	150	1800	A-C	2200V.	
1	150	900	G. E.	I-K(2200V.)	15
1	125	1800	West.	CS	
1	100	1800	Whse.	CS	663C
1	100	1200	Whse.	CS	752C
1	100	900	G. E.	MT356 Slpr.	
1	100	600	A-C	2300V.	

NEW MOTOR STARTERS

1—Size 3, Whse. Combination, circuit breaker, Nema 1, 3/60/440
21—Size 2, G.E. Combination fusible, 60 and 100 amp, 3/60/220, CR7008A42C
88—Size 1 Whse. life line, 3/60/220
7—60 thru 200 HP EC&M, 3/60/2300 Size 10 Magnetic Compensators

GEARMOTORS

1—20 HP, 400 RPM, Westinghouse ID-XP
1—10 HP, 88 RPM, Master, parallel shaft output
3—10 HP 55 RPM, Whse. Fr. 324, parallel shaft output
1—7½ HP, 11 RPM, Whse. Fr. 284Y, TEFC
1—5 HP, 155 RPM, U.S. Fr. 254, parallel shaft output
13—Cleveland right angle worm gear reducers, rated 5 HP-1150 RPM, 7½ HP-1750 RPM, 6-1 ratio, Series 215, Size 50 RT, Class 1
4—Ratio 10-1, Series 25F—ditto

NEW INGERSOLL-RAND MOTOR PUMPS

Amt.	GPM	HD.	Type	Motor Encl.
2	140	90	2—ORVL-7½	TEFC
2	134	90	2—ORVH-5	XP-1-D
1	1500	35	5—KVL-25	XP-1-D
1	1½ x 1½		AC, SSL	XP-1-D

OISC-TRANSFORMERS—Single Phase

Amt.	KVA.	Make	Type	Volts
9	37½	G.E., Moloney, Whse.		2400-240/416
2	50	Wagner	HEX	4000-1328/2300Y
3	75	Whse.	S	2400/4160-480/240
3	100	West.	S	2400/4160—115/240/480
3	150	Moloney	HE	4000-230/460

PARTIAL LISTINGS—10,000 OTHER MOTORS IN STOCK—SLIPRING—SYNCHRONOUS. NEW MOTORS AT LONG DISCOUNTS.

BENSON-WILIMZIG, INC.

1708 North 8th St. Phone—Garfield 1-4290 St. Louis 6, Missouri

BOILERS
1—350 HP Hedges-Walsh Weidner 225 psig

CIRCUIT BREAKERS
1—1200 amp G.E. FKHO-236, 15 KV, 3 pole
1— 400 amp West. GI, 73 KV, 3 pole

DIESEL GENERATORS
1—300 KVA Superior YLO—G.E. Gen. 400 RPM 2200/440/3/60

MOTORS—SQUIRREL CAGE
1—150 HP 1800 RPM 440/3/60 West. CS-771
1—150 HP 3600 RPM 2200/3/60 West. CS-6756H

MOTORS—SLIP RING
1—400 HP 250 RPM 440/3/25 G.E. I-12 S.B.
1—360 HP 350 RPM 2300/3/60 G.E. IM S.B.
1—200 HP 1800 RPM 440/3/60 G.E. LE13B S.B.
1—200 HP 1800 RPM 2200/3/60 G.E. I S.B.
1—150 HP 600 RPM 2200/3/60 G.E. I-M S.B.
1—150 HP 720 RPM 440/3/60 G.E. OI S.B.
1—125 HP 600 RPM 440/3/60 G.E. I-12 S.B.
1—100 HP 600 RPM 2200/3/60 G.E. I-12 S.B.

MOTORS—SQUIRREL CAGE—EXPLOSION PROOF
2—75 HP 1800 RPM 2200/3/60 G.E. K-505S

TRANSFORMERS—1 PHASE 60 CYCLE
3—3333 KVA 66000 to 33000 & 13200 v.
2—1000 KVA 13200-2300 v.
3— 500 KVA 38100/66000 Y—2300 v.
3— 500 KVA 33000 v—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000 v.—2300/4160 Y
5— 200 KVA 13200—2300/4160 Y
1— 200 KVA 12000—2300/4160 Y
3— 200 KVA 7620/13200 Y—2300
1— 150 KVA 66000—2300/4160 Y

TRANSFORMERS—1 PHASE 60 CYCLE
14—100 KVA 33000-23000/4160 Y
9—100 KVA 13200-2300/4160 Y
6—100 KVA 7620/13200-2300/4160Y

TURBO GENERATORS
1000 KW West. Cond. 185 lbs. 100° SH 3/60/2300
1500 KW G.E. Non-Cond. 140 lbs. 3/60/2300
1000 KW G.E. Non-Cond. 140 lbs. 3/60/2200

PUMPS—BOILER FEED
600 GPM 1220' hd. DeLaval 3550 RPM Requires 250 HP
600 GPM 1220' hd. Conn. 233 HP 3550 RPM 400 lb. pres. DeLaval turbine
400 GPM 1250' hd. Worthington 1750 RPM 5" x 4"

CENTRIFUGAL PUMPS
5200 GPM 55' hd. Worthington 18 x 14, 1150 RPM 100 HP reqd.
5000 GPM 214' hd. Pennsylvania 15½ x 14, 1775 RPM 300 HP required.
4375 GPM 100' hd. DeLaval 14 x 12, 1270 RPM
3500 GPM 37' hd. DeLaval 12 x 12, 1160 RPM 60 HP req'd.
3200 GPM 50' hd. Gardner Denver 10 x 12, 1160 RPM 60 HP required.
3500 GPM 160' hd. DeLaval 10 x 10, 1750 RPM, 200 HP req'd.

MOTOR GENERATORS
1000 KW 600 volts DC 514 RPM West. 2300/3/60
48 KW 30 volts DC 600 RPM Stanley Elect MG 75 HP 220/3/60
16.8 KW 42 volts 1800 RPM Hertner 220/2/60

AIR COMPRESSOR
750 CFM 17 x 12, 55 psi, single stage Ingersoll-Rand Type ER1, 75 HP.
530 CFM 14 x 10, 100 psi, single stage Ingersoll-Rand Type ER1, 100 HP.
310 CFM 8 x 12 x 8 50 psi, single stage, steam driven Ingersoll Rand Type FR1.

GENERATORS—GAS ENGINE
99¾ KVA, 230/3/60 Star Buda with charger
66½ KVA 240/3/60, 4 wire Waukesha-Bardco Type C12 truck mounted

SYNCHRONOUS MOTORS
400 HP 1800 RPM 2200 volts Westinghouse .8 PF
300 HP 400 RPM 2200/440/3/60 General Electric Type T8
290 HP 720 RPM 2200/3/60 General Electric Type AT1 pedestal bearings
150 HP 1800 RPM 2200/3/60 General Electric Type ATI with dir. con. exc.

GENERATORS—STEAM ENGINE DRIVEN
65 KVA 327 RPM 220/3/60 Engberg 9 x 10 vertical engine.
160 IHP 260 RPM Skinner steam engine 15 x 15, 100 lbs. 5 lbs. back

MOTORS—GEARHEAD 3 PHASE 60 CYCLE
40 HP 494 RPM General Electric Type K-444 Vertical parallel shaft
3 HP 220 RPM Kelley Compactor TE vertical
½ HP 0.508 RPM Universal, Type K-18282 parallel shaft

MOTORS—VERTICAL 3/60AC
75 HP 1750 RPM U.S. Type CFU-950 hollow shaft
50 HP 1800 RPM G.E. Type KT-531Y hollow shaft
40 HP 1800 RPM G.E. Type KT-323 Solid shaft
30 HP 1200 RPM U.S. Type SCV-937 Solid shaft

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BOILERS

Three combustion engineering four drum stirling type 714 horsepower 50,000 pounds per hour 233 P.S.I. Built 1934.

Two Babcock and Wilcox three drum H type 400 horsepower 160 pound P.S.I. Built 1943.

These boilers are in excellent condition suitable for hog fuel. Gas, coal or oil firing. Available now.

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FOR SALE WATER PUMPS
Purchased in 1944 — Never Used

1. DeLaval Steam Turbine pump (centrifugal) serial #244389, 1770 rpm, Capacity 2000 gpm, Head 290 feet.
Driven by Westinghouse induction Motor serial #1443, 200 H.P., 2200 volt, 3 phase—60 cycle, 1775 R.P.M.

2. DeLaval Steam Turbine Pump (centrifugal) serial #244388, 1740 rpm, Cacapity 1200 gpm, Head 325 feet.
Driven by Westinghouse Induction Motor serial #5243, 125 hp, 2200 volt—3 phase—60 cycle, 1740 R.P.M.

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Boilers	Motor Generator Sets	Oil & Air Circuit Breakers
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COMPLETE BOILER PLANT
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80 H.P. and 150 H.P. Horizontal Return Vogt Boilers with Stokers, piping, valves, electrical equipment, etc. Will sell units separately.

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BOILERS—FOR SALE
2—B&W class 111—M 30 sterling 4 drum boilers 350 lb working pressure—66,000 lb per hr containing 8600 sq ft heating surface—foster water cooled walls ASME code—induce and force draft—complete in every respect—foundation space 22' long 19' wide 28' high—quick delivery—price on application.
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- SWITCHBOARDS

M. G. SETS

KW	Make	AC	DC
2400	West. (3-u.)	4800	525
1000	West. (3-u.)	11000	137/275
500	AC-West.	2300	250
450	G. E. (3-u.)	2300	125/250
400	A. C.	2300	120/240
300	Cr-Wh.	440	250
200	G. E.	440	550
200	West.	2300	275
200	G. E.	440	600
150	G. E.	2300/440	250
150	G. E.	2300/4000	125/250
150	G. E.	440	275
125	G. E.	440	300
125	West.	440	250
100	G. E. (25 cy.)	440	125
100	G. E.	2300	250
100	Ridgway	2200	275
100	West	220	125
100	Elec. Machy.	220	125
90	G. E.	220	250
90	G. E.	440	60
75	Reliance	2300/440	250
75	G. E.	440	125
60	A. C.	2300	110
50	G. E.	440	250
40	A. C.	220	125
35	West.	2200	125
30	G. E.	220/440	250
25	Cr-Wh.	440	125
20	G. E.	440	250
20	Bogue-GE	550	250
20	Bogue-GE	220/440	125

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	Speed
2000	*G. E.	MT-12	600
2000	*G. E.	MT-30	287
1500	*G. E.	MT-30	240
1250	*West.	CW	600
1000	*West.	CW	250
700	*A. C.	ANY	720
500	*G. E.	IM	3600
500	*G. E.	MTP	1800
500	*G. F.	MT	450
500	West.	CW	350
400	A. C.	3-brg.	450
400	*G. E.	MT412	450
350	West.	CW	900
300	*G. E.	IM13A	1800
300	*G. E.	MT410	450
250	West.	HF15H	600
200	G. E.	IM15	1200
150	G. E.	MT549 BB	1800
125	*G. E.	MT549	1800
125	G. E.	IM15A	600
100	A. C.	ANY	900
100	G. E.	IM13A	1800
100	G. E.	IM15A	450
75	Northw'n	HW50	1800
75	G. E.	MT347	1200
75	G. E.	MT356	900
75	G. E.	IM	720
75	G. E.	IM14	600
60	West.	CW762C	900
50	G. E.	IM11A	1800

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

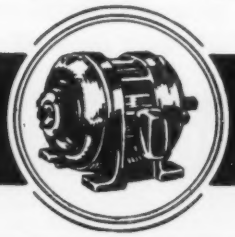
HP	Make	Type	Speed
1750	*G. E.	K	3600
1000	*G. E.	K63478	1800
750	*A. C.	TEFC	1800
750	*G. E.	KT	720
700	G. E.	FT	3600
500	*A. C.	6316SW	1800
400	*G. E.	KF559	3600
300	*West.	CS	3600
250	*L. Allis	OGX148	720
250	G. E.	IK	600
200	*G. E.	FT549Y	3600
200	A. C.	ARW	3600

AIR COMPRESSORS

Sizes	Make	Type	PSI	Displs
10x11	Worth.	HB	100	294
11x12	Worth.	HB	100	426
12x13	Worth.	HB	125	460
20x12 by 14	Sullivan	WN4	100	2032

If you don't find what you need wire, write or phone for complete stock list.

PHONE: CANAL 6-2900



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COMPRESSOR VACUUM PUMP SERVICE

AMERICAN AIR of JERSEY
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SELL—BUY—TRADE—RENT—REPAIR
A RENTAL COMPRESSOR FOR EVERY JOB

55 CFM Lindsay (GAS) Portable
60 CFM Worth—CPT—Portable
89 CFM 6 x 7 Worthington HB, 15 HP Elec.
105 CFM Worthington—1R—CPT Portable
107 CFM 7—7 x 7 Ingersoll FS-I STEAM
122 CFM 7 x 7 Ingersoll ES-I 20 HP
142 CFM Ingersoll Semi-Portable 25 HP
160 CFM 1R-Worth Portable
165 CFM Smith 110SR Semi-Portable, 25 HP
167 CFM 10 x 5 Ingersoll Vacuum Pump—7½ HP
195 CFM 8—9 x 9 Worthington HS STEAM
210 CFM Worthington (GAS or DIESEL) Port
211 CFM 9 x 9 Chicago T-B 30 HP Elec.
279 CFM 11—10 x 11 Worthington HS Steam
294 CFM 10 x 11 Worthington HB 50 HP Elec.
315 CFM Worthington (GAS or DIESEL) Port
434 CFM 14 x 7 Ingersoll Vacuum Pump—15 HP
492 CFM 13½/9 x 10 Chicago O-CB Duplex 75 HP Elec.
600 CFM Worthington (DIESEL) Portable
628 CFM 14 x 13 Ingersoll ES-I, 100 HP
720 CFM 18 x 7 Worthington HEV Vacuum Pump 25 HP
868 CFM 17/10 x 12 Chicago O-CB Duplex 150 HP Elec.
1184 CFM 22 x 9 Chicago T-VB Vacuum Pump 40 HP
1633 CFM 24 x 11 Chicago T-VB Vacuum Pump 60 HP

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COMPRESSORS SINCE 1902

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Modern Heavy Duty

DIESEL ELECTRIC UNITS

1—150 KW, Atlas-Imperial, 2400/4160 Volts, 360 RPM.

1—500 KW, Worthington, 2400 V, 360 RPM.

SUNDFELT EQUIPMENT CO., INC.
220 Hudson Seattle, Wash.

POWER PLANT COMPLETE

2 Phase—225 Volt—60 Cycle A.C. and all Auxiliaries

1—219 K.V.A. Westinghouse Steam Turbine driven A.C. Generator.
1—312 K.V.A. Skinner Universal Uniflow Steam Engine Driven Crocker Wheeler A.C. Generator.
1—250 K.V.A. Skinner Uniflow Steam Engine Driven Westinghouse A.C. Generator.
1—25 K.W. Westinghouse Steam Turbine driven D.C. Generator—Exciter Unit—125 Volts.
1—25 K.W. Synchronous Motor Driven D.C. Generator Exciter Unit.
1—8 Panel Switchboard with all instruments, etc.

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2980 West Davison Ave.
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FOR SALE BOILER

1—150 HP Leffel Scotch Marine 125#
2—Peerless feed water pumps; one with electric motor; one steam turbine—6 stage

NATIONAL BOILER & EQUIP. CO.
1501 S. Senate Ave., Indianapolis 25, Ind.

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SATISFIED CUSTOMERS REPEAT ORDERS
HAVE BUILT THE VOLUME BUSINESS
WE DO SELLING

HEMPHILL *Guaranteed* EQUIPMENT

DIESEL GENERATOR SETS

3—75K2A C.W., 120/208 V., 3 Ph., 1200 RPM. V Belt, to KRUPP. 3C1/L., 2 cy. solid injection complete.

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1000	G. E.	Auto	3	4150x2400
2	750	G. E.	HT	3	4150x120/240
2	750	G. E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts	OISC	1	4800/4150/2400 x240/480
3	344	Whse.	OISC	1	2400x575
1	333	G. E.	H	1	13200x220/440
2	300	G. E.	H	1	13200x440
4	200	G. E.	H	1	13200x440
1	200	G. E.	HT	3	2400x240
2	150	Pitts.	OD8C	1	240x120/240
3	50	G. E.	H	1	4800x120/240
3	40	A. C.	H	1	230x120/240
1	25	G. E.	H	1	460x120/240

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	500	G. E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
2	200	Whse.	600	CW	440
1	200	G. E.	600	MT	440
1	150	A. C.	1800	AY RW	2300
1	100	G. E.	1800	IM	220
1	100	G. E.	600	IM	440
1	75	G. E.	600	IM	440
3	60	G. E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G. E.	1200	MPC
2	150	C. W.	900	WP
1	125	G. E.	1700	RC
2	75	C. W.	900	WP
1	30	C. W.	700	CM
1	35	G. E.	860	RC
1	25	Whse.	835	SK

WESTINGHOUSE M.G. SET

1000 KW, 600V D.C., 2400/4160V, 720 RPM, 3 Ph., 60 Cy., 7 PF Syn. Motor. Direct Connected Exciter, Motor Driven Rheostats, Switch Boards, all for full automatic operation.

SQUIRREL CAGE MOTORS

Qu.	Make	Speed	Type	Volts
150	G. E.	720	KT	440
125	G. E.	3560	KF	2300
100	G. E.	1200	FTR	220
75	Ideal	1200	AT	220/440
60	G. E.	1200	KT	220
50	G. E.	3560	FT	220
50	G. E.	600	KT	440
40	G. E.	3550	FT	440
30	G. E.	600	KT	440

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G. E.	514	600	2300/4150 Syn
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C. W.	1200	230	3-unit 2400/4150SR
1	300	G. E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C. W.	1200	230	440 SC
1	150	3 Unit G. E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C. W.	1200	125	2300 S.C.
1	100	G. E.	900	250	2300 Syn.
3	60	G. E.	1200	125	208 Syn.
2	30	G. E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G. E.	720	ATI	2300
1	150	G. E.	720	ATI	2300
1	150	G. E.	1800	T8	220
1	150	Whse.	900	ISIG	220

OIL CIRCUIT BREAKERS

3—600 AMP. G. E. FKR-55-20, 15,000 V. 3 P. 100,000 KVA, SOLENOID OPER.

1—600 AMP. G. E. FK-143, 15,000 V. 3 P. 50,000 KVA. Manual with Disconnects, Metal Clad Enclosure.

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I-R 50 HP, 2 STAGE, MODEL 50T

GEAR HEAD MOTORS

220/440/3/60-BALL BEARING, PAR. SHAFT

QUAN.	MFG.	HP	INPUT	OUTPUT	FRAME	SIZE	DISC.
30	G.E.	7½	1750	580	284	5306	TEFC
7	Link Belt	20	1750	74.4	364	DM-70	TEFC
5	G.E.	25	1750	352	365	KR	TEFC-XP
6	G.E.	40	1750	561	405	4.WL	TEFC
7	G.E.	60	1750	427	445	4.WL	TEFC

SQUIRREL CAGE MOTORS

150 HP, G.E. 600 RPM, 220/440/3/60 PED. BALL BRG.

50 HP, G.E., 900 RPM, 220/440/3/60 XP-1D, K505S

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1—E. Keeler Company Water Tube Boiler, 310 H.P.

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And Gear Reduction Units

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1—Westinghouse 100 H.P. Steam Turbine and Gear Reduction Unit.

These units are in excellent condition and priced reasonably. They are designed for inlet steam pressures of 105 and 90 lbs. respectively and 15 lb. back pressure. They can be used efficiently with higher initial steam pressure.

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330 W. 42nd St., New York 36, N. Y.

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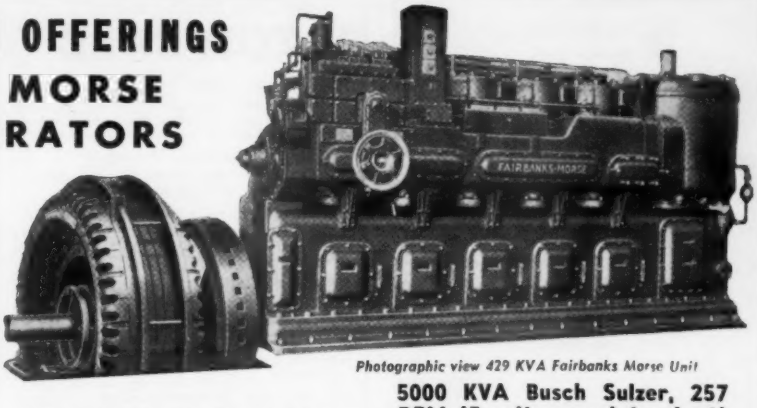
FAIRBANKS MORSE DIESEL GENERATORS



Photographic view 429 KVA Fairbanks Morse Unit

Complete Installations

500 HP Fairbanks Morse Diesel engine Model 33-F-12, 5 cylinders, 400 RPM. 12" bore, 15" stroke direct connected to a: 429 KVA—343 KW, 80% PF, F. M. generator 3/60/2400 volts. *LIKE NEW. INSTALLED 1948.*

690 HP Fairbanks Morse Diesel engine Model 33-E-14, 6 cylinders, 300 RPM, 14" bore, 17" stroke direct connected to a: 592 KVA—473 KW, 80% PF, F. M. generator, 3/60/2400 volts. *EXCELLENT CONDITION INSTALLED 1949.*

111 KVA (2) Fairbanks Morse 300 RPM, 3 phase, 60 cycle, 2400 volts.

250 KVA Buckeye, 450 RPM, 3 phase, 60 cycle, 2400 volts. EXCEPTIONAL BARGAIN.

5000 KVA Busch Sulzer, 257 RPM (5 units complete plant) 3 phase, 60 cycle, 2400 volts.

3750 KVA General Motors (3 units complete installation) 720 RPM, 3 phase, 60 cycle, 2400/4160 volts.

375 KVA General Motors, Model 8-268A, 1200 RPM, 3 phase, 60 cycle, 440 volts.

UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • CH. 1-0210

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

TRANSFORMERS, *Just released sgl. ph.*

161 DRY TYPE—1½ KVA to 100 KVA in various combinations, 2400/480/240 V. Primaries, 440/220/110 V. Secondaries.
28—OIL COOLED—5 KVA to 167 KVA in combinations 4100/2400/480 V. primaries. 440/220/110 V. secondaries.
SAFETY SWITCHES—200 to 1200 amps., 440-5000 V.
MAGNETIC STARTERS 7½ HP to 200 HP, 440 V. 3 pole
MAGNETIC SWITCHES 5 HP to 200 HP, 440 V.
OIL CIRCUIT BREAKERS 200 to 600 amp. 5000 V.
8—150 KW GE RECTIFIERS, 275 V. DC x 3/60/2300 V.

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30 CHURCH ST. NEW YORK 7, N.Y.

SHARPLES CENTRIFUGES

4 type M-324H-13, 2 never used, 2 used 700 hours. Also parts and tools.

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RUTLAND, VERMONT

GUARANTEED REBUILT,
220 or 440 VOLT, 60 CYCLE, 3 PHASE, SQUIRREL CAGE and SLIP RING MOTORS

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
350	G.E.	IM-17B	600	slip ring, S.B.
250	G.E.	KT 564	900	B.B.
150	G.E.	KT 549	1800	S.B.
150	G.E.	IM	1200	slip ring, S.B.
150	G.E.	KT 564	600	B.B.
125	L.A.	FX 505S, new	1800	B.B. splash proof
100	L.A.	JA 505S, new	1800	TEFCBB
100	L.A.	FX 504S, new	1800	B.B. splash proof
100	Cr. Wh.	SC	1200	TEFCBB
100	G.E.	KT 337	1200	S.B.
100	West.	CS 607	1200	S.S.B.
100	G.E.	MT 356	900	slip ring, S.B.
100	F-M.	H-205C	900	B.B.
100	G.E.	IM	720	S.B. slip ring
100	West.	CW	600	slip ring, S.B.
75	West.	CS 504	1800	TEFCBB
75	West.	CS 445	1800	B.B.
75	G.E.	MT 343	1200	slip ring, B.B.
60	Ideal	AH 444, new	1800	S.B.
50	Ideal	A 405, new	1800	S.B.
40	L.A.	OGX 404, new	1800	drip proof, S.B.

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8 CAIRN ST., ROCHESTER 2, N.Y. P.O. BOX 534 Tel. Genesee 5629

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ELECTRIC POWER EQUIPMENT

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	RPM
1	2200	G. E.	MCF	600	400/500
1	2000	Whse.	Mill	600	230/460
1	1200	G. E.	MCF	600	750/950
1	940	Whse.	QM	250	140/170
1	900	Whse.		250	450/550
1	825	Whse.		250	95/190
1	600	Al. Ch.		250	400/800
1	500	Whse.	CC-216	600	300/900
1	500	G. E.	MCF	600	300/900
2	450	Whse.		550	415
1	400	G. E.	MCF	550	300/1050
1	300	Whse.	CB-5094	250	575/1150

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G. E.	MT-408	2300	360
1	1500	ABB		2300	720
1	1200	G. E.	MT	2300	275
2	1000	A. C.	Mill	2300	240
1	1000	G. E.	MT-452	2200	321
1	500	G. E.	M-574Y	6900	900
1	500	Whse.	CW	550	350
1	450	G. E.	IM	440	720
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G. E.	MT-442 Y	2200/4000	253
1	350	G. E.	IM-17A	440/2200	720
1	250	G. E.	MT-424-Y	4000	257
1	250	G. E.	MT-5598	2200	1800
1	250	Al. Ch.		550	600

SQUIRREL CAGE

2	650	G. E.	FT-550RY	440	3570
2	450	Whse.	CS-1420	2300/4150	354
1	300	Whse.	CS	440	1170
1	200	G. E.	IK-17	440	580
3	200	G. E.	KT-557	440	1800
1	150	Whse.	CS-8568	440	880
1	150	Whse.	CS	440	580
1	150 75	G. E.	IK	440	900/450
2	125	Al. Ch.	ARW	2200	1750

SYNCHRONOUS

1	4350	C. W.	3501-8L	13860/6900	514
2	3500	G. E.	TS	2300	257
2	2100	G. E.	ATI	2300	360
2	1750	G. E.	ATI	2300	3600
2	2000	Whse.		2300	120
3	735	G. E.	ATI	2200/12000	600
1	720	G. E.	TS	2300/4600	720
1	500	Ideal	SM	2300/4160	1800
1	500	Whse.		440	900
1	450	Whse.		2200	128 5
1	450	Whse.		2200	450
1	400	G. E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	D.C. Volts	A.C. Volts
2	2000/2400	G. E.	450	250/300	2300/4600
2	2000	G. E.	450	600	2300/4600
1	2000	G. E.	500 25cy	660	11000
2	2000	G. E.	514	600	6600/13200
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514 30/11	600	4000/13000
2	1000	Whse.	900	600	4160
3	1000	G. E.	720	600	2300/4600
1	1000	G. E.	900	260	6600
1	1000 (3U)	G. E.	900	250	2200
1	750	Whse.	900	275	4160
1	750	C. W.	514 30/11	600	2300
1	600	G. E.	720	250	440/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	5000	Whse.	OISC	3	3300x26400
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66060/138000
1	1500	G. E.	HT	3	13200x2300
3	1000	G. E.	HVDDJ	1	2400x480
6	1000	Wagner	OISC	1	13200x460

FREQUENCY CHANGER SETS

Qu.	KW	ake	Freq.	Voltages
1	12500	Whse.	60/25	132\0/13200
1	3000	G. E.	60/25	2300/2300/4000
2	2500	G. E.	25/62.5	2300/2300
1	1000	G. E.	25/58.3	4400/2300
1	500	Al. Ch.	2560	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G. E.	Condensing 425—750 F. T. T. Surface Condenser 3/60/2300/4000 V Direct conn exciter.
1	1500	Whse.	Auto-extraction 150 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Div. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.E.P. 480/3/60.
1	750	G. E.	Condensing 265 # I.S.P. 440V, 3 ph. 60 cy.—New—1944
1	750	Whse.	—Non-condensing 1 to I.S.P. 40# B.P. 750 Kw. 280 V. D.C.

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(3) SCOTCH MARINE BOILERS
225 pounds working pressure. Approximately 17,500 pounds each, per hour.

(4) 300 KW G.M. 8-268A DIESEL GEN.
G.M. diesel generator sets—120/240 volts DC—1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

NEW 60 KW CUMMINS DIESEL GEN. SET
60 KW—120 volts DC

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.
Heavy duty—totally enclosed—with built-in switchgear. 75 KW—230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS
120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740° TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL
510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

ELECTRIC WINCHES
50 HP—230 volts DC—built in controls—5 ton and 10 ton.

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TWO UNUSED PELTON WATER WHEEL IMPULSE TURBINES
330 H.P., 1000 R.P.M. for effective head of 433 ft., with needle nozzles but less governors; also complete set spare parts. Write
FS-2817, POWER
330 W. 42 St., New York 36, N. Y.

BOILERS

4—1200 H.P. B&W Sectional Steel Header Cross Drum Boilers, 225# design pressure, Mfg. in 1924. Code. All usual accessories. Lower rows retubed in 1950. Located in N. Y. State.

2—824 HP Sterling Boilers, 1930, active certificate for 300# W.P. chain grate stokers, ELESCO superheaters, all auxiliaries, Austin, Minn.

3—600 HP, B. and W. longitudinal drum, sectional header boilers, A.S.M.E. 225# steel headers. Located N. Y. State.

2—509 HP, B. and W. Boilers, 1916, retubed 1952 209# W. P. Lawrence, Mass.

1—490# Walsh-Widener Cross Drum, Sectional Headers, 4" tubes, 1927, 450# W. P. all auxiliaries. West Point, Virginia.

1—400 HP Keeler C. P. Boiler, 1942, 160# W. P. new tubes and refractory, TODD mechanical oil burner and pump set. Overhauled, dismantled. Ready to ship. N. Y.

Complete plant consisting of:
2—20,000# pr. hr., 160# W. P., 1942, B. and W. steam generators, deaerating heater, all boiler auxiliaries. A complete plant. San Fernandino, Florida.

1—310 HP Keeler C. P. Boiler, 160# W. P. 1942, pressure parts ship in one piece. Lake City, Florida.

1—250 H.P. B.&W. Sectional Steel Header Boiler, 250# W. P. All usual accessories and trim, mfg. in 1924. Location—Florida.

WARNER J. SHERB, INC.
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FOR SALE

1 complete Fairbanks Morse plant—3—225 HP, 1—150 HP Model 32E14 with 185 and 156 Kva Generators—240-480 volts—3—360 HP Model 32E Fairbanks, 300 Kva Generators.

Other units 120 to 700 HP—Fairbanks Morse parts I buy, sell or trade.

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SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	440	Whse.	1800
600	2200	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
400	440	G. E.	900
300	4000/2300	Whse. (new)	600
300	2200/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
250	440	G. E.	600
200	440/220	Whse.	514
200	440	G. E.	450
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
150	550/220	G. E.	720
145	4000/2300	G. E.	1800
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G. E.	TS	1200
300	2200/440	G. E.	TS	1200
250	2200/440	G. E.	TS	720
250	440/220	G. E.	ATI	1200
250	2300	G. E.	TS	3600
250	440/220	Whse.	HR	277
250	2200/440	G. E.	TS	1200
250	440/220	G. E.	ATI	600
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
110	440/220	G. E.	TS	257

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200	Whse.	CS	514
500	2200/4000	Elliot	SC	1800
500	2200	G. E.		450
400	2200	G. E.		360
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
250	2200/440	G. E.	IK	720
225 (2)	2200/440	G. E.	KT	1200
200	2200/440	G. E.	K	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
200	2200	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	440/2200	G. E.	IK	514
150	2200/440	G. E.	KT	600
125	440/220	G. E.	KT (vert.)	1200
100	2200/440	G. E.	K	1200
100	220/440	G. E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-pf.	1800
50 (2)	410/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	X-prf.	600/1200

A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G.E.
1—300 kva. 900 rpm. 480/220 V., G. E.
1—250 kva. 720 rpm. 2300/440 V., G. E.
1—225 kva. 600 rpm. 220/440 V., G. E.
1—200 kva. 720 rpm. 2200/440 V., G. E. (Ball brg.)
1—187 kva. 1200 rpm. 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28. 600 amp., 15,000 V., G. E., Sol. opr., draw-out.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	Whse.	SK	2870
200	230	G. E.	CD	750
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
100	230	Cr. Wh.	CMC	625
90	230	G. E.	CD	1750
80	230	G. E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440/220	Syn.	250
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250
65	G. E.	2200/440	sq. ca.	125
45	G. E.	440/220	sq. ca.	250

TRANSFORMERS 60 Cy.

3—667 kva, Al. Chal., 22000/11000/2300 V.
1—600 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, G. E., 22000/11000-2300 V.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G. E., 12000—2300 V.
3—200 kva, G. E., 2300—575 V
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, G. E., 33000—2300/4600 V.
3—150 kva, Al. Chal., 2400—240/480 V.
3—150 kva, Al. Chal., 2400—240/120 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G. E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3—50 kva, Whse., 440—220/110 V.
6—50 kva, G.E., 2400—120/240 V.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

12 SPECIALS

62 KVA GE 3-60-440/220 v.—Sterling GASOLINE unit; Portable.
100 KVA GE 3-60-440/220 v.—Sterling GASOL'NE unit; Portable.
250 KVA (2) Wghse 3-60-240/480 v.—7 cyl. DIESEL units.
185 KVA (2) Fairbanks Morse DIESEL units 32E14; 3-60-240/480 v.
125 KVA (2) GE 3-60-220/440 v.—Hercules DIESEL units.
300 HP Keeler package BOILER #250.
250 HP B&W "H3" BOILER 225#.
250 HP (2) Return Tubular BOILERS 150#.
107 HP Kewanee Package BOILER 125#.
625 KVA Al. Chal. TURBO unit; non-cond. 3-60-480/240 v.
150 KVA (2) GE TURBO unit; non-cond. 3-60-240/480 v.
125 KVA GE TURBO unit; non-cond. 3-60-240/480 v.

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1 YEAR GUARANTEE

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125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg.	1200
150	Westg. (3)	900
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
50	Westg. (2)	1150

PLUS 40 additional units ½ to 40 KW

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
750	G. E. (2)	NEW
500	G. E.	500
400	G. E.	NEW
250	Cr. Wh.	1200
200	El. Mchy.	900
150	G. E.	1200
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150
60	N. W.	1150
40	Rel.	1750
40	G. E. 3-Unit	1150
25	G. E.	1200
17	A-C	1750
15	Star	1750
10	G. E.	1150

PLUS 15 additional units ½ to 7½ KW

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NEW YORK 13, N. Y.

Est. 1910 44th YEAR

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Diesel-elec. generator sets, 250 KW to 1000 KW.
Allis-Chalmers 625 KW turbo-gen. set, cond.
Portable cranes, Whirley, crawler, track type.
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300 RPM to 900 RPM Input
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300 KW New Baldwin DeLaverne 6 cyl. Mod. VO 400 RPM w/DC 120 240 V West. Gen.
100 KW GM 6 cyl. Mod. 6228 1200 RPM w/AC 3/60/440 V G.E. Gen.
50 KW Cat. 6 cyl. Mod. D8800 900 RPM w/AC 3/120-208 V Louis Allis Gen.
40 KW New Buda 6 cyl. Mod. 691 1200 RPM w/DC 120 V Burke Gen.
30 KW Int. Harv. 4 cyl. Mod. UD14 w/AC 120-208 V Century Gen.
150 KW New West. DC 240 V 1200 RPM 225# Pres./3260 RPM Turbine thru reduction gear
200 KW Al. Chal. AC/3/60/240 V/3600 RPM driven by DeLaval dir. connection
500 KW West DC 120-240 V 1200 RPM

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HYacinth 5-0800

WANTED A NON-CONDENSING TURBO GENERATOR IN GOOD CONDITION AS FOLLOWS:

1000 KW at 80% P.F. 2300 Volts 60 Cycles, 3 phases. To carry full load with 100 pound gauge pressure and 15 pound gauge—back pressure and suitable to stand up to 150 pounds pressure.

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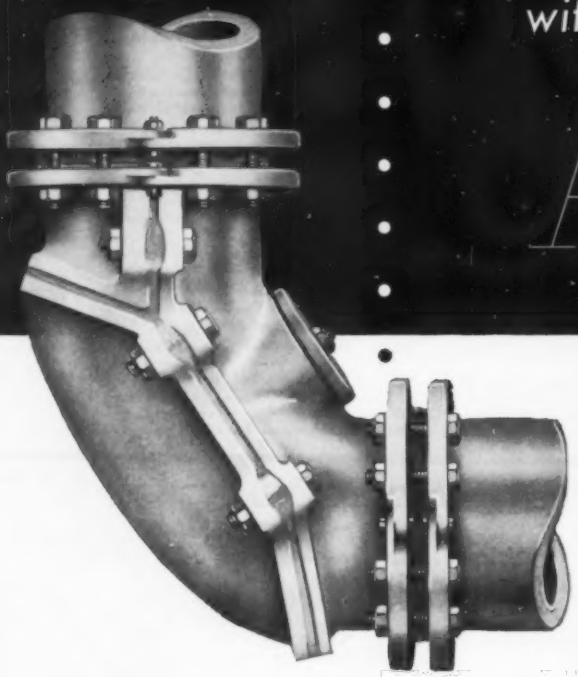
CHICAGO FIRE BRICK BUILDS BETTER ASH CONVEYING SYSTEMS

with

ABK METAL



Chicago Fire Brick Company 4-piece elbow design made better with ABK Metal wear backs.

■ The Chicago Fire Brick Company, manufacturers of heat resistant ceramics and ash conveying systems, standardizes on ABK Metal parts where extreme abrasion is a major factor of wear.

Their experience in manufacturing and installing many power station ash handling and materials handling systems has proved that the ABK Metal parts give much longer service than ordinary "abrasion resistant" materials.

The confidence that Chicago Fire Brick places in ABK Metal castings is typical among those companies who use ABK castings to fight abrasion. Its service record is outstanding.

Benefit by the experience of others. Specify the exclusive nickel-chrome Brake Shoe castings with controlled matrix structure and hardness. ABK Metal will give you the extra service required for profitable operation.

QUALITY CASTINGS IN **ABK METAL MEEHANITE®**

AMERICAN **Brake Shoe** COMPANY

BRAKE SHOE AND CASTINGS DIVISION

230 Park Avenue, New York 17, N. Y.
109 N. Wabash Avenue, Chicago 2, Illinois

Houston St. Louis San Francisco Toledo

2369

Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

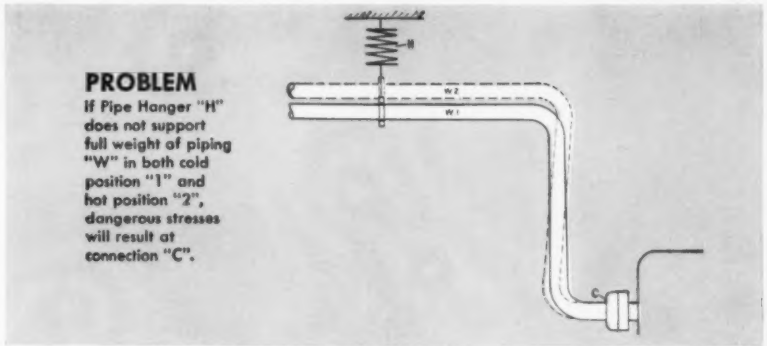
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

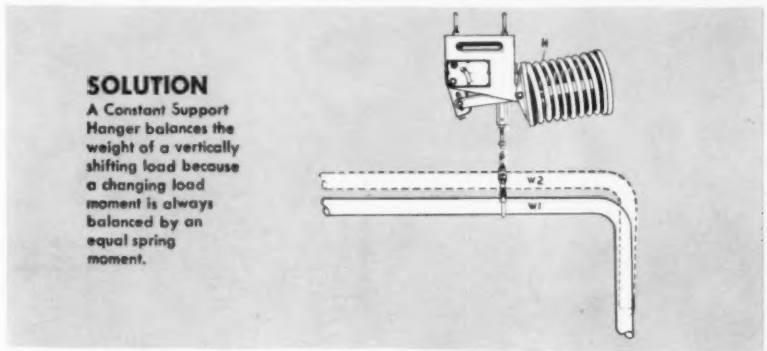
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

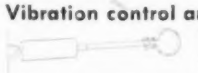

PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".
H
W 2
W 1
C


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.
H
W 2
W 1

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

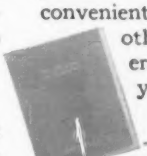
Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.



GRINNELL COMPANY, INC.

278 West Exchange St., Providence, Rhode Island

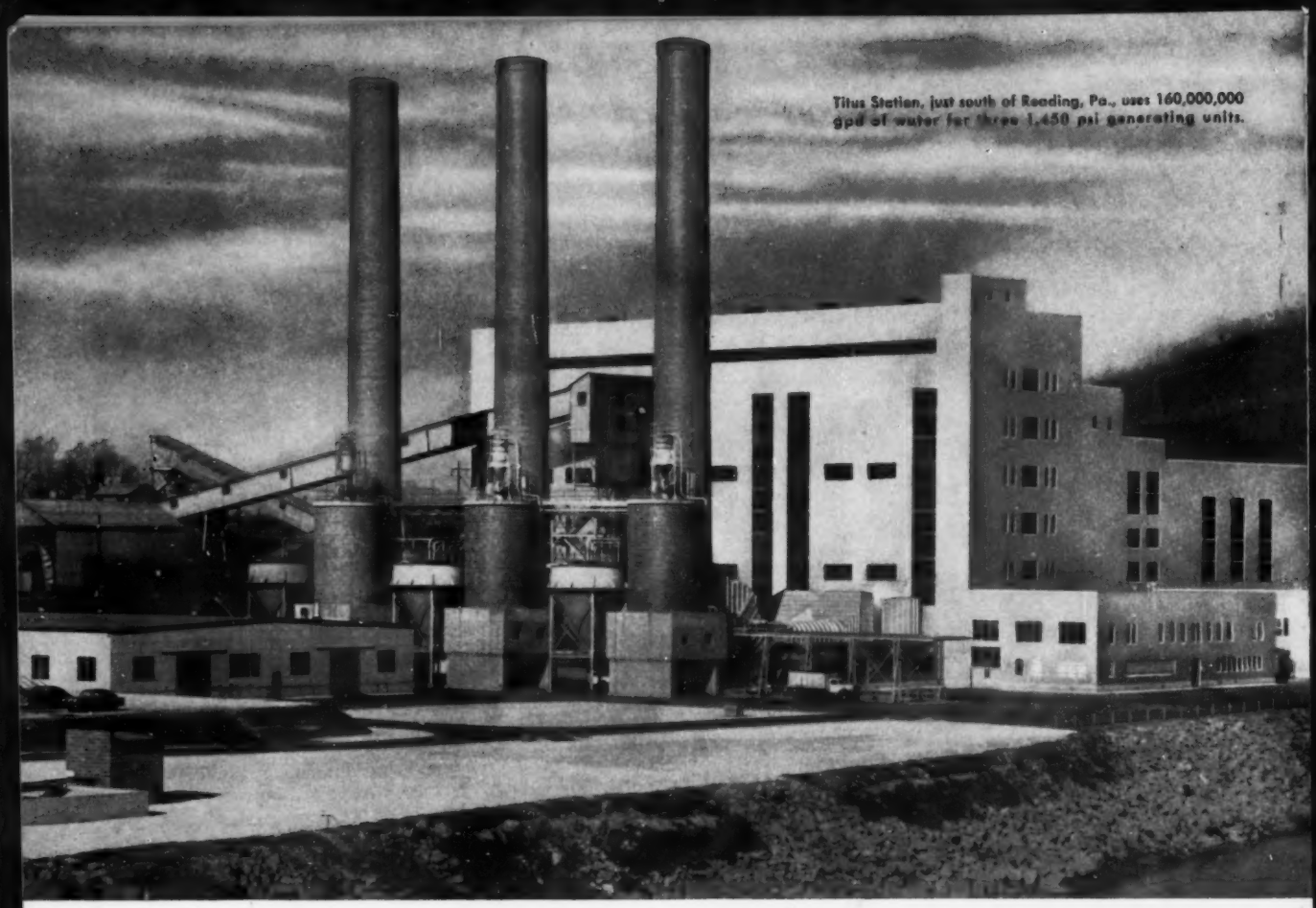
Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

Name.....

Company.....

Address.....

City..... State.....



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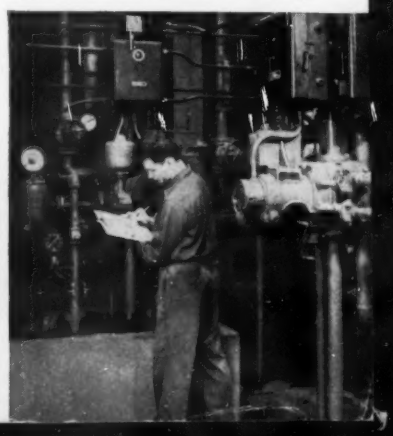
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